GENDER AND INCLUSION

8.2

DLTV
JOURNAL

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Editorial

Roland Gesthuizen, Matt Harrison, Clark Burt and Natasha Dwyer.

Journal Editorial Team

The past two years of battling COVID in Australia has repeatedly tested our ability to deliver teaching and learning of digital technologies with cracks appearing due to challenges from variable online access and digital equity. This time is an important moment to question and critically reflect upon our commitment towards equity and inclusion in our society.

Local and international events over the last couple of years have brought gender and inclusion to the forefront of the public consciousness. Building on the vital work of Adam Goodes, Grace Tame and the recent appointment Dylan Alcott, Australia has started to pay attention to the voices of those who historically have been denied a voice. As a microcosm of broader society, Digital Teaching and Learning Victoria is consciously trying to promote the voices of Digital Technologies teachers who have not always been provided with the opportunity to share their successes, their innovations and theirs concerns.

To do this, our organisation needs actively reach out and connect with those people who have felt excluded or unwelcome, and to ask how we can create a safe and supportive environment in which they feel like part of our community. As part of this process, this issue to dedicated to those people who have been doing transformative work for a long time without necessarily receiving the recognition.

Our journal issue 8.2 begins with a reflection of our DLTV Life member, Leon Gus. We pause to remember his pioneering work decades ago in Victoria to support the rollout of one-toone computing in our classrooms. Take time to look over the the contribution by DLTV teachers following the many 2021 VCE Conference and Applied Computing events. These were wonderful opportunity for regional and metropolitan teachers to meet face-to-face alongside new graduate teachers entering our profession. Dr Linda McIver, director of ADSEI has written an interesting reflection about the emerging field of High Performance Computing (HPC) used to help simulate, analyse and solve problems. She later reminds us that “Diversity means more than Girls”.

Celeste Pettinella writes as an emerging education leader in 2021 and notes that whilst we appeared to be ruled by technology, if you scratch the surface then it is really about using technology to help each other. Our journal showcases the wonderful contribution to our subject association of DLTV community members: Jessica Rowlings and Jo Blannin who each share something about the things that inspire them most. Robogals is a favourite topic by Miranda Gee, who writes about how this activity can be used to inspire STEM Education to a new generation of girls. Margeret Lawson interviewed Alice Boxhall to

discuss her career as a leading Software Engineer to shine a light on how technology can improve the lives of others. We also showcase the competition winners of the Victorian Coding Challenge.

Dwi Wahyudi from Monash University, shares a paper from Indonesia about designing and developing a web-based virtual lab of the concept of blood types. His fascinating research explores how we can address some of the safety and ethical issues in a virtual study and learning environment that simulates a real laboratory. Hanshu Wang and Yiming Xue from Monash University share a paper that considers how we can enhance Chinese Character learning in a MOOC with Augmented and Virtual Reality tools. It is interesting to explore the design thinking that they employed for their research project.

We acknowledge that there is a lot of work to do, both as a country and as an organisation. This editorial was written in the week that Grace Tame didn't smile and young women wondered if society would like to control their faces as well as their bodies. And the Australian Open runner up, Daniil Medvedev insulted a chair umpire by calling him a derogatory word for the female anatomy and this hardly caused a blip in the media. The social category of gender and the need for inclusion will be crucial topics for educators for some time.

Today's students may face a world that is even more hostile for those without privilege, but we can create education spaces now that empower and give student a sense that their future professional worlds should be about knowledge and the development of ideas, no matter who you are. In this edition, we present a range of strategies practitioners are implementing now to make the world a better place.

We look forward to hearing what you think and your strategies to enable greater equality and inclusion.

From the President

Ben Gallagher

At the beginning of 2021 we were optimistic that life would return to something equating with 2019, where DLTV could cautiously hold our in-person events and return to collaborating with our members in their schools and classrooms. We were also excited to see teachers harness the digital pedagogical lessons from 2020 and bring new ways of doing things in their schools as they returned to shared physical spaces. Unfortunately as we all know, 2021 had other plans and once again our members bounced between remote and in-person teaching. While it is easy to discount this as another lost year for our children and young adults, what we saw again was the amazing resilience and innovations within our community. You, our members and friends, are at the heart of everything we do and I would like to highlight some of the contributions you have made over the past year.

Our organisation consists of a growing network of amazing volunteers and supporters, generous with their time and enthusiasm even when many have had great personal and professional challenges. These are the often quiet people who tirelessly make things happen behind the scenes. I'd like to especially thank our volunteer committee members who dedicate their time to help make DLTV a meaningful, teacher-focused organisation. For example, our DigiCon conference sub-committee have spent the last two terms meeting regularly to plan and organise an exciting program that meets the needs and interests of our diverse membership. We will have more news on DigiCon soon, so please keep and eye our for our regular e-newsletters. Likewise, our journal sub-committee has been going the extra yards to ensure that our members receive a high quality publication that can build on and celebrate our collective professional knowledge. Our journal sub-committee is capably led by Roland Gesthuizen, a life member of DLTV.

Beyond overseeing and supporting our professional staff in running our exciting events, they also perform some tasks which may be described as less glamorous. There are many other volunteers working behind the scenes, including our finance sub-committee or our fabulous patron Paula Christophersen, who is always on hand to give support or offer advice. I'd also like to thank the members who have been helping with materials for some of our ongoing projects, whether it has been creating and sharing creative commons content, presenting at a webinar or being part of an interview panel.

Looking ahead, there is so much to look forward to in 2022. While there is still much uncertainty, I know that many of our members are looking forward to spending more consistent time with their students. This is not to downplay the exciting opportunities present by all of the innovations that have come about over the past two years, but rather an acknowledgement that we can have the best of both worlds. We hope to celebrate this new world at DigiCon and at our other events throughout the year. As always, the journal is also a place where we want to celebrate what you are doing to use digital technologies to enhance learning and to build strong school communities. If you have an idea for an article or a project profile, please contact the editor. Finally, I want you, our loyal members and supporters, for helping our organisation to continue in advocating for and supporting high quality digital learning and teaching. Stay safe and stay connected.

VALE LEON GUSS OBM

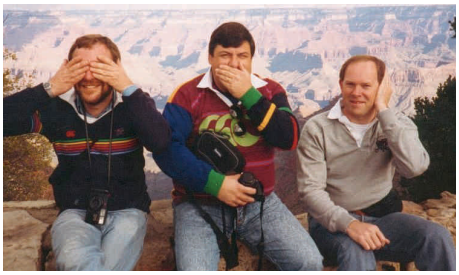
A REFLECTION OF THE IMPACT ON DIGITAL LEARNING IN SCHOOLS BY A NUMBER OF COLLEAGUES WHO TAUGHT AND WORKED WITH HIM THROUGHOUT HIS CAREER.

For many of us, Leon Guss was an understated, thoughtful achiever who was always involved in 'yet another' innovative educational project. His passing came as a shock for many. His guidance, his understanding and his wisdom will be sorely missed.

After spending thirteen years teaching and four years at **Apple Australia**, Leon joined **Methodist Ladies' College (MLC)** in 1994 as their Director of Computing and Multimedia. He arrived at a point in time when the educational world was in a state of excitement and a state of flux. Leon was pivotal, along with Steve Costa, David Loader (former Principal of MLC) and Gary Stager in supporting and rolling out one-to-one computing into the classroom.

Tony Carrucan, former Director of Information Technology at St. Michael's Grammar School, recalls his collegial relationship with Leon in the 90s, as friendly adversaries in the quest to be innovative leaders in the one-to-one computing landscape. He recalls that even though there was a bit of a "cold war" for technological innovation between St Michael's Grammar, MLC, Wesley, Scotch College and other grammar schools, Leon invited Tony to visit MLC where he welcomed him like an "old friend". Tony recalls that Leon took him into "his inner sanctum and his passion and fundamental honesty was on show". Leon was all about outcomes and new tools for teachers and students to express themselves in ways we had never imagined.

Linda Sharlow (former Head of Mathematics at MLC) reflects that "Leon was not to be drawn to the flashing lights of 'the new' without thinking carefully about purpose and how a program, website or tool could actually have a positive impact on how young people learned and whether teachers could use it effectively." This was evident in the way in which he went about encouraging teachers to embrace and then apply new technology in their classroom; fostering pioneers by showcasing their skills for others as the whole school came together to create their own MLC Edtech conference where teachers were encouraged to share how they were using technology in their classrooms.



Marylou Monaghan (MLC eLearning Coordinator) fondly recalls how Leon "delighted in showing us how new technologies worked and facilitating ways for us to trial new tools. He was measured in how he presented the facts and implications of changing technology at meetings. He always had a serious look but when he had a new device to show us he did crack a smile." Leon was involved in many projects at MLC from rolling out one-to-one computing, to developing MLC's Learning Management System and Intranet/Internet sites.

Leon knew how to play the long game, how to work with people, listen to their concerns and encourage the small steps from their individual starting points that would constitute their journey. When you approached him with an idea you would often be greeted with a thoughtful gaze and you could see the cogs ticking over in his head.

Warwick Wynne (former MLC Director of Learning and Curriculum) reflects on his time working with Leon. He had a "wry and under-stated sense of humour, the flash of a smile, a supportive colleague, committed always to the original vision of the laptop as a powerful learning tool for students."

When talking with his colleagues we know that Leon knew that mandating technology use in the classroom meant very little unless it was used to develop better learning and teaching, not merely *different* learning and teaching.

Leon's generosity in enabling and empowering others in the educational technology landscape will be remembered through his significant role in establishing the **ICT Managers' Forum**, which morphed into what we now know as the **Victorian ICT Network for Education (VINE)**.

Tony Carrucan explains the way in which Leon brought together Directors of IT across many independent schools across Melbourne and encouraged them to work as one unit to drive the agenda of one-to-one computing. "Leon taught us that by working together we could combine to influence tech companies to build computers for schools", he reflects. "We rode the crest of the wave as the consortium travelled together to Japan to meet the NEC CEO and senior management to explain our collective vision and Leon was our anchorman."

Clarke Stevenson attests to his business acumen and the way in which he "challenged [his] sales skills and taught [him] the art of negotiation". Leon was in charge of a large computing budget at MLC, and Clarke reflects that "his pan-faced, folded arm posture, initially terrified, but then challenged me". Leon maintained his professional networks with sales representatives from many companies, and he could call upon them for help with his projects.

Gary Stager reflects that "Leon Guss was indispensable to schools, conferences and organisations trying to get things done". He is in awe of his tireless work ethic, lack of ego, and "his ability to make the trains run on time". Gary jokes that , "while the rest of us were sleeping, enjoying a presentation, or celebrating; Leon was hard at work making our lives easier", and we can see this in the legacy that he has left us.

Even though Leon put on a serious face, many colleagues reflect on his dry sense of humour. Suzette Boyd, former Head of Library at MLC reflects that she "was constantly surprised by his seemingly bottomless bag of Jewish jokes". Gary Stager reflects that "despite his lovable, but gruff facade, I will always cherish the twinkle in Leon's eye when he delighted at one of us being naughty."

In recent years, even though retirement and his classic car was calling him he returned to work at Scotch College managing ICT Projects.

Leon's legacy to global schooling in one-to-one computing can never be underestimated. He was granted **life membership of the DLTV (CEGV)** in recognition of his contribution to computing education in Victorian schools and impact on educational technology.

It is with fondness that many remember Leon and sadness that he has left us, but he will always be remembered. Leon lost his battle with Lymphoma on Tuesday 28th September 2021.

We send our condolences to Sarah Guss and family. Donations can be made to Lymphoma Australia:
https://www.mycause.com.au/p/265242/in-memory-of-leon-guss-1feb1954-28sep2021

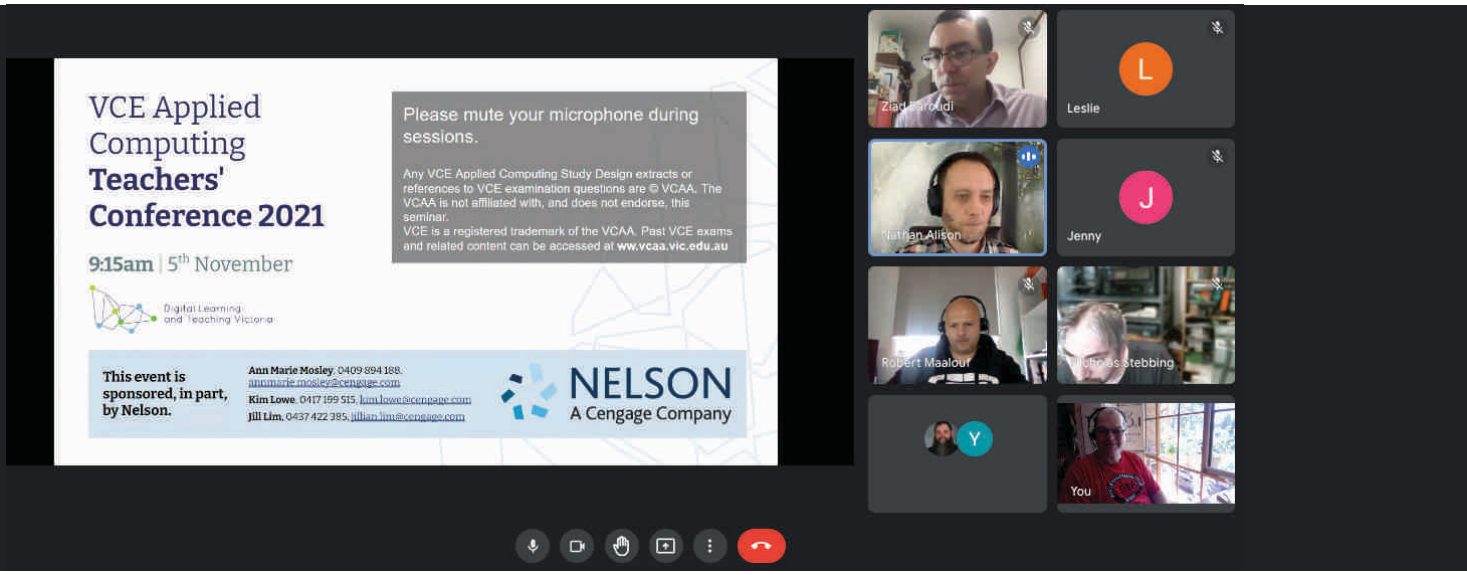
Further Reading:

1:1 25 Years On! Reflections by Leon Guss, Methodist Ladies College (2015)
http://www.aalf.org/articles/view.php?ArticleID=217

BITS AND BYTES

Correspondence, conversation starters and short thoughts from our community.
If you have something to contribute please email the editors at publications@dltv.vic.edu.au

From DLTV Professional Learning Coordinator
Nathan Alison



2021 was DLTV's second year planning and hosting an online format for the annual conference for teachers of VCE Applied Computing.

With the interruptions of COVID and a study design that is still quite new, our VCE Subcommittee has strived to put together each event in such a way that both new and experienced teachers can take away useful information and ideas.

In spite of the challenges thrown up by two very tough years in schools, we've been delighted that teachers have still stepped up to share their teaching practice with their colleagues, and that participants have also contributed so much during the sessions.

A virtual format requires difficult compromises in terms of session lengths, attendees' interactivity, and balance of content throughout the day.

While core sessions were not recorded, topical sessions from 2020 and 2021 are available on DLTV's YouTube channel at **this playlist** with topics including; Agile software development methodology, data tools like Wolfram and Tableau, network security and cyber security, data ethics and data integrity. Also included are two presentations from tech schools in Victoria.

Nothing is certain, but we look forward to returning to face-to-face PL for VCE teachers in 2022, while still providing options for regional teachers to connect in.

WHAT I TOOK FROM THE DLTV VCE APPLIED COMPUTING TEACHERS' CONFERENCE

By Ziad M Baroudi

Ziad M Baroudi teaches Mathematics and Digital Technologies at Avila College, Mount Waverley. He has particular interests in teaching algorithms, computer programming and beginning algebra. He blogs occasionally on **www.ramblingteacher.com**

In the last two years, I have attended the DLTV VCE Applied Computing Teachers' Conference. What I learnt in 2020 gave me confidence in teaching Unit 1 Applied Computing this year and I look forward to applying what I learnt in the 2021 conference to my first Data Analytics class in 2022.

What I learnt in 2021

The most important takeaway from the 2021 conference was getting to know a few current teachers of Applied Computing. Prior to this, I had been part of the small and closely-knit VCE Algorithmics community.

I left that conference, or rather logged off at the end of the day, with a good sense of the level that was required in the Unit 1 SACs. I learnt that many schools used the Tkinter library for user interfaces in Python and Tableau for data visualisations. It was at that conference that I learnt that secondary schools could apply for a free Tableau educational license so I went ahead and did that.

What I learnt in 2022

This time around, I concentrated on the Unit 3 and 4 talks and I took copious notes. I am now re-evaluating the database I used this year, MySQL with Workbench, and will use the summer to build up my skills with Tableau since I need to teach year 12s how to create dynamic visualisations.

I learnt that using Google Forms as a reflection tool was a great way to do authentication during the SAT that spans two outcomes, one in each unit. I also picked up a few teaching tips such as giving students ready-made designs for data collection forms and then challenging them to create alternatives to those.

Conclusion

When teaching something for the first time, we all need two things: Contacts with experienced teachers and good teaching ideas / tools. I have found the annual DLTV VCE conference to be a great forum for both of those requirements and I recommend all VCE teachers, especially new ones, attend it as well.

One more thing: DLTV's VCE Applied Computing Resource Kit is an absolute must have!

VCE Applied Computing Conference 2021

By Bernie McGrath

Bernie McGrath is a Digital Technologies and Mathematics Teacher at Kew High School. He is a member of the Committee of Management of DLTV and the VCE Subcommittee.
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The VCE Applied Conference brings together the VCE Computing community to share practice and build supportive professional networks. The online format enabled greater representation, both from teachers in regional Victoria and from those that struggle to gain time release. Additionally, the online format prompted broader sharing of the pedagogy, with all attendees witnessing the conversations that typically occur in small groups at lunch.

The audience of Unit 1 and 2 sessions discussed gender diversity in VCE Applied Computing and the sustainability of the study. One of the most significant changes to the Unit 1 and 2 study is the introduction of the Innovative Solution Area of Study, at Unit 2. The diversity of projects undertaken and approaches to the delivery of the Area of Study was enlightening. Several attendees advocated limiting project teams for the innovative solution to pairs, to make it easier for students to make equitable and meaningful contributions. The projects that students completed included an online assessment portal, a habit tracker website and a set of customised VR gloves which supported learning a virtual piano.

Attendees of the Software Development stream were challenged to reflect on how they prepare students for exams throughout the year. Attendees discussed the different approaches they take to submission of SAT Criteria and assessing Key Skills in Unit 3 Outcome 1.

We are very fortunate to have a collegial VCE teaching community. The more we collaborate, the better we support the learning outcomes for all students of VCE Applied Computing and the more attractive the Study is likely to be to prospective students.

Thank you to all presenters and attendees.

Applied Computing Units 1 and 2
Suggested Resources

The following resources were suggested attendees of Unit 1 and 2 sessions.

Programming Resources for Unit 1 Outcome 2 and Unit 3 Outcome 1

replit
Online IDE and Programming education platform
https://replit.com/

CodeBoard
Online IDE with task setting and LMS integration options
https://codeboard.io/

GROK Learning
Australian Based online programming learning environment.
https://groklearning.com/

goormide
Online collaborative IDE.
https://ide.goorm.io/

PyCharm
Online Python IDE
https://www.jetbrains.com/pycharm/

Visual Studio Code
IDE with smart completion and syntax awareness.
https://code.visualstudio.com/

Additional Resources to Support Applied Computing

ACS Career Wheel
Provides ICT career insights for students.
https://qldictgisp.acs.org.au/career-pathways.html

Blogpost on the difference between project requirements and scope.
https://blog.pmsprout.com/project-requirements-vs-project-scope-statement/

Airtable
A hybrid database and spreadsheet solution that some schools use for Unit 1 Outcome 1.
https://www.airtable.com/

IGCSE Resources
Past IGCSE papers can be useful resources for developing VCE Applied Computing teaching and assessment resources.
https://pastpapers.papacambridge.com/papers/caie/cambridge-upper-secondary-igcse-ict-0417

Inspiration for Innovative Solutions
Unit 2 Outcome 1.
https://www.youtube.com/watch?v=h4T_LIK1VE4
https://teachablemachine.withgoogle.com/
https://media0.giphy.com/media/lj11uKKMhr4Os/giphy.mp4?cid=e2a3cbdesz4iplzsnaxdhcc52z7frv35f2xq82uvtal766fw&rid=giphy.mp4

Network Simulators
Unit 2 Outcome 2.
https://www.netacad.com/courses/packet-tracer
https://netsim.erinn.io/
https://projects.bardok.net/educational-network-simulator/
http://malkiah.github.io/NetworkSimulator/simulator01.html#

SO MANY FLAGS, SO LITTLE TIME.

Capture the Flags (CTFs) involve several information security themed challenges that students complete to unlock flags, for which they are awarded points. The cumulative nature of the point scoring supports students in understanding the value of defence in depth strategies in protecting networks and the effectiveness of smokescreens and decoys in mounting attacks. The GROK Academy hosted Schools Cyber Security Challenges provide an excellent introduction to key ideas that students can pursue further through capture the flag activities.

Kew High School has been trialling blue teaming and CTFs since 2017. CTFs provide an engaging way to introduce information security concepts and help to identify students who might otherwise apply their interests in undesirable or illegal contexts. Students need to apply a broad range of digital technologies knowledge to successfully complete a CTF but most challenges include entry level tasks accessible to a broad range of students. Below is a list of popular CTFs which are relevant to secondary students.

As individual students show a passion for these challenges, they often seek to better understand real world information security challenges. It may be useful for these students to subscribe to podcasts such as Risky Business or Darknet Diaries or to follow the blogs of popular Australian security experts, such as "Alex" at the mango zone.

Capture the Flags

Lonetree Saburra

https://lonetree.xyz/ctf/saburra/

Saburra was created by Adam Brickhill from Edith Cowan Uni in WA. It is a great entry level CTF. Adam is building out further challenges. Saburra is useful as an extracurricular challenge aimed at Years 7-10.

Cyber Start Intern Base:

https://play.cyberstart.com/

Cyber Start Intern Base has replaced Cyber Start Go. The free challenge content that maps into the Year 7-8 Digital Technologies curriculum. The challenges are accompanied by a Field Manual that explains the principles applicable to each challenge.

Pico CTF

https://picoctf.org/

Pico CTF is maintained by Carnegie Mellon University and hosts a collection of learning resources and practice challenges. The content is typically relevant to students studying VCE Applied Computing, VET Cyber Security or Undergraduate Information Technology degrees.

Hack Challenges

https://ctf.hackchallengesforkids.com/

This Dutch CTF has a range of challenges suitable for Years 5-12. The challenges contain brief learning resources to introduce each of the concepts explored.

Downunder CTF

https://downunderctf.com/

The Downunder CTF was a scheduled challenge that ran in September 2021. Kew High School did not participate but the organisers have produced a detailed blog post on how to host a scalable CTF on cloud infrastructure.

https://medium.com/@sam.calamos/creating-scalable-ctf-infrastructure-on-google-cloud-platform-with-kubernetes-and-app-engine-8c0a7847a53c

Host or write your own.

https://www.vulnhub.com/

As school's mature on their CTF journey they may wish to consider running up some images from **VulnHub** so that students can identify and patch or resolve vulnerabilities. Be cautious as some of the images may contain unadvertised malicious content. In a school environment these images are best used in an air gapped environment.

ThreatGEN: Red vs. Blue

https://store.steampowered.com/app/994670/ThreatGEN_Red_vs_Blue/

ThreatGEN: Red vs. Blue is not strictly a CTF but rather a multiplayer game strategy game designed to teach defensive and offensive security concepts. This game is useful at progressing the information security knowledge and skills of later secondary students.

Some VCE SAT RESOURCES

By Litsa Tzelepis htzelepis@msj.vic.edu.au | **Shared on Edulists**

To help with the VCE SAT, here are some resources suggested by other teachers.

The True Size Of is also great at comparing country size when you drag the country on the equator. That may be helpful at some stage if working with populations. **https://thetruesize.com**

Chart.js

Data-Driven Documents

Google Charts

tableau

infogr.am

Power Map

MAPMINER

Maptitude Geographic Information System

Tagxedo

Templates

VENNGAGE

batchgeo

Excel

ProjectLibre™

High-Performance Computing (HPC)

By Dr Linda McIver

Executive Director ADSEI

McIverlinda@adsei.org

High-Performance Computing (HPC) is changing the world. From our understanding of coronavirus to climate simulations, supercomputers give us the power to simulate, analyse, and solve a vast array of problems. There are great examples of Supercomputing applications on the Pawsey website at https://pawsey.org.au/case-studies/ from neonatal healthcare and real-time astronaut monitoring, to meteorite craters on Mars, from mapping marsupial DNA to quantum computing.

Problems like climate change can't be modelled or solved without supercomputers, as there's simply too much data. Using a supercomputer can take something that would take literally years to process and run the calculations in minutes.

The Supercomputing conference in St Louis this year has a wonderful range of resources on different careers in HPC (they're a lot more diverse than you think!), cool applications of HPC, and classroom activities on HPC and Data Science. Check out the Supercomputing Youtube Channel at https://www.youtube.com/user/SCconferenceseries/videos

A YEAR DOMINATED BY TECHNOLOGY

by Celeste Pettinella

As I sit down as a teacher to reflect on 2021, it seems to be one where the technology ruled. What happened?

Email

Using emails is a familiar way for teachers to communicate that changed we share things in schools as we mull over-sharing by face to face or electronic? I certainly like the buzz and bounce when we meet in a school as it sometimes more difficult to read without the face. I found Joan's emails on tips or her help with edits to be helpful and us being able to email quotes is a nice way to add some pep in one's step.

Remote Learning

As the COVID pandemic rolled on, I embarked on a remote learning journey again, meeting my Year 5 class online with Video conferencing (WebEx). I made better use of our learning management system for submitting learning tasks and Epic for guided reading sessions (Compass)

Professional Development

With our learning happening online, there were many opportunities for professional development and even new opportunities such as DLTV events and workshops, even with informal coaching when Roland taught me some basic skills in Microsoft Teams. Joining a virtual staff induction staff meeting with my new was a real highlight and chance to get to know people I will soon work with in 2022.

Courses

I completed this year my Bastow course and Growth Coaching course, meet some incredible people including Trevor who had inspiring educational stories and was a helpful facilitator. I completed a postgraduate study in TESOL, studying online each Tuesday evening at Victoria University with Dr Oksana to unpack the Victorian English Additional Language Curriculum and adapt with my current student. Teaching online placements with students from a migrant and refugee background helped by Suresh and Emir from Community Plus has helped me better understand teaching English as Second Language.

Career

I searched for and submitted a job application (DETVic Recruitment Online). It is so interesting to consider today that schools do not want to see hardcopy applications and this year, we interviewed online (Webex or Zoom). I was rather excited to be invited to help with the new leadership team a Clyde Creek Primary School with founder Principal Jodie Bray and founder Assistant Principal Sarah Smith and state-of-the-art buildings.

Coaching and Mentoring

David T mentored me by running numerous mock interviews and sharing some powerful analogies then following up phone calls. Later he shared that this coaching was keeping him agile and alive during the periods of home isolation. It is wonderful to find somebody who has the experience to share, is articulate and takes an interest in your goals. Through video conferencing, Loretta helped shape my career and build my professional resilience. I have found it so beneficial to have a coach and mentor that I am going to continue working with to achieve new goals. If you find the right person who fits your teaching and learning style, treasure the time that you have with them and hang on tight.

Socialising

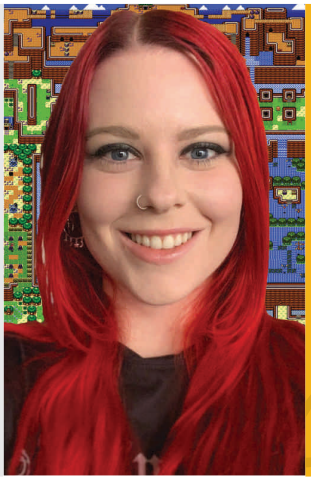
Technology loaned itself to enable me to socialise with friends and family from Facetime calls, online fitness classes and even when I celebrate our LMC Toastmasters 100th Birthday party. The interactive and online party was a surprising success as members wore party hats, listened to music, watched a slideshow and tasted items shared from delivered party bags that contained a cake and cookies.

Reflection

This year was one that seemed to be ruled by technology but when I look closer, it was something more. During my remote teaching and learning, job hunting, professional development and socialisation, the late nights, hard work, determination and family support from my mother, father, sister and others. I learned something that you cannot read from a book or figure out by yourself. At each step of the way, I was deeply connected with other people to climb new walls, hold onto each other as we rode through each new wave. I was never alone.

I am better, happier and stronger. I am an education Leader. I am ready for 2022.

Community MEMBER



Jessica ROWLINGS

@jessrowlings

Jess Rowlings is a University of Melbourne researcher and speech pathologist who uses digital games as teaching tools for children and young adults for developing collaborative problem solving skills and building social connections. She is also proudly neurodiverse herself and is passionate about inclusive education.

WHAT ARE YOU DOING NOW?

My background is originally speech pathology, but I am now co-founder of the social enterprise Next Level Collaboration, which uses co-located cooperative video games to teach collaborative skills to neurodiverse children. We are an inclusive, neurodiverse-led organisation that uses strength and interest-based learning to promote social capacity building and a sense of belonging.

On top of this, I also work in research at the University of Melbourne under the Melbourne Graduate School of Education.

WHY DO YOU THINK IT IS IMPORTANT TO HAVE DIVERSITY IN DIGITAL TECHNOLOGIES EDUCATION?

Humans are incredibly diverse, and it's really important to promote inclusivity and incorporate a wide range of perspectives to reflect this. Digital technology itself is also constantly growing and evolving to improve inclusivity, such as the introduction of assistive controllers for game consoles. There is so much diversity amongst our learners, and everyone should have the opportunity to learn from other people like them. Representation matters!

WHAT IS THE MOST SIGNIFICANT EXPERIENCE IN YOUR CAREER?

Being part of Next Level Collaboration has been the highlight of my career for so many reasons. Not only are video games part of my job, but I also have the privilege of working with fantastic kids who I think teach me as much as I teach them! I am very lucky to have the opportunity to make real change through my work, and it is so rewarding to see the kids I work with develop their skills, confidence, and self-esteem over time.

WHAT INSPIRES YOU?

I find inspiration in others who are driven to make change or follow their passion regardless of preconceptions or stereotypes, especially women. Greta Thunberg, Katherine Johnson, and Margaret Heafield Hamilton are all incredible women that I draw inspiration from every day.

WHAT IS YOUR FAVOURITE DIGITAL THING?

Video games! I have been an avid gamer since I was a kid and now I appreciate the value of games as not only fun, but also as great tools to facilitate learning. I'm always excited for new releases, but the Super Nintendo and its classic titles will always hold a special place in my heart.

Community MEMBER

Jo BLANNIN

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@joblannin
https://research.monash.edu/en/persons/jo-blannin

As a sought-after international leader in digital pedagogies and STEM education, Dr Blannin offers a 20+ year career in educational innovation and change leadership. Her current role at Monash University is as Senior Lecturer, Digital Transformations. Her previous roles include leadership positions in schools, education systems, banking, business, outdoor education and private consultancy.

As a higher education teacher, Jo has been recognised as providing models of best practice in innovative teaching as well as an ongoing engagement with research through University and international awards. Her background in education and teaching in three countries and in two languages means she consistently brings research and evidence-based practices into her work to the benefit of both her students, research partners and colleagues.

WHAT ARE YOU DOING NOW?

Sitting on the couch (!?!). No, I have several research projects that are looking at the way that digital technologies can enhance inclusion for children and adults. One I'm really excited about is working with some new VR technologies that enable a class of pre-service teachers to be in the same (virtual) classroom and watch a teacher in action. Then we help them unpack the 'hidden curriculum' aspects of teaching.

Such as when the teacher walks towards a certain student, or highlights/repeats a word, or rephrases a question. It's hard to explain why that happened or get student teachers to notice those things after the lesson concludes but in the VR world we can pause and all notice these micro-moments as they happen. The VR aspect is fascinating in itself as each PST can look around the virtual space and take their own perspective, and so they 'notice' different things. They are in the same space but see very different things which makes for an enlightening discussion!

WHY DO YOU THINK IT IS IMPORTANT TO HAVE DIVERSITY IN DIGITAL TECHNOLOGIES EDUCATION?

Diversity is reality! The world isn't homogenous and so digital technologies education needs to reflect that reality. Everywhere we look there are new ways of doing things that make sense to some people and less to others - like scanning QR codes rather than signing in to the shops - we need to provide diverse technologies that meet the needs of our diverse populations.

WHAT IS THE MOST SIGNIFICANT EXPERIENCE IN YOUR CAREER?

I'm lucky that I've had lots of significant experiences. I think that what they all had in common though was a feeling of being trusted to take risks and try new ways of teaching and learning. From teaching geology by digging holes on a beach in Michigan, teaching English in France through hiphop music and creating Art using Micro:bits, I've been so lucky to be supported by leaders who said, 'why not!' and let me try new things. Even when my ideas didn't always turn out as planned, I learned a lot!

WHAT INSPIRES YOU?

I'm always inspired reading about teachers who clearly love teaching. It's a vocation and I've always been proud to be a teacher. After two years of remote learning, I think it's fair to say that many more non-teachers are inspired by our profession!

WHAT IS YOUR FAVOURITE DIGITAL THING?

Currently? I think I'd have to say my new telescope! I have a new ZWO ASI telescope camera that I'm learning to use and it is a lot of fun - although much more fun when it's warm outside!

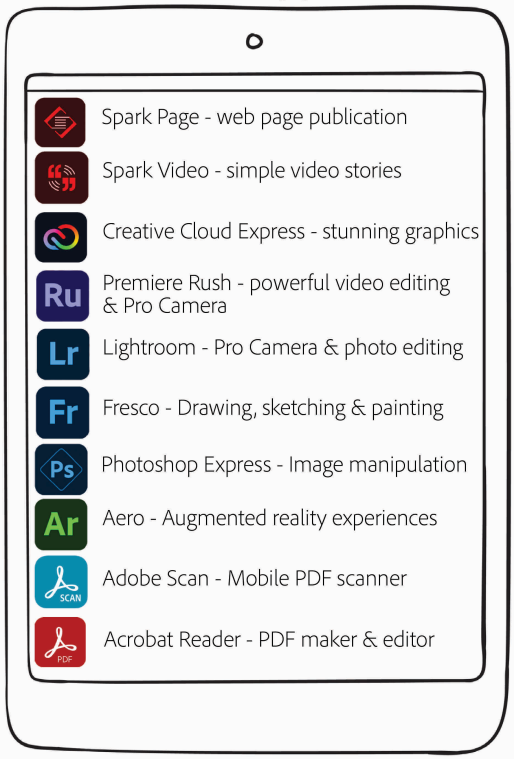
Adobe Creativity apps for Victorian Schools

The Victorian & NSW governments have provided the Adobe Creative Cloud (https://creativecloud.adobe.com) to all of their secondary schools and most independent and catholic schools also have access.

If your school does not have access, you do have the new Adobe Creative Cloud Express for Education apps because they are free for all K-12 school globally - https://www.adobe.com/education/express/

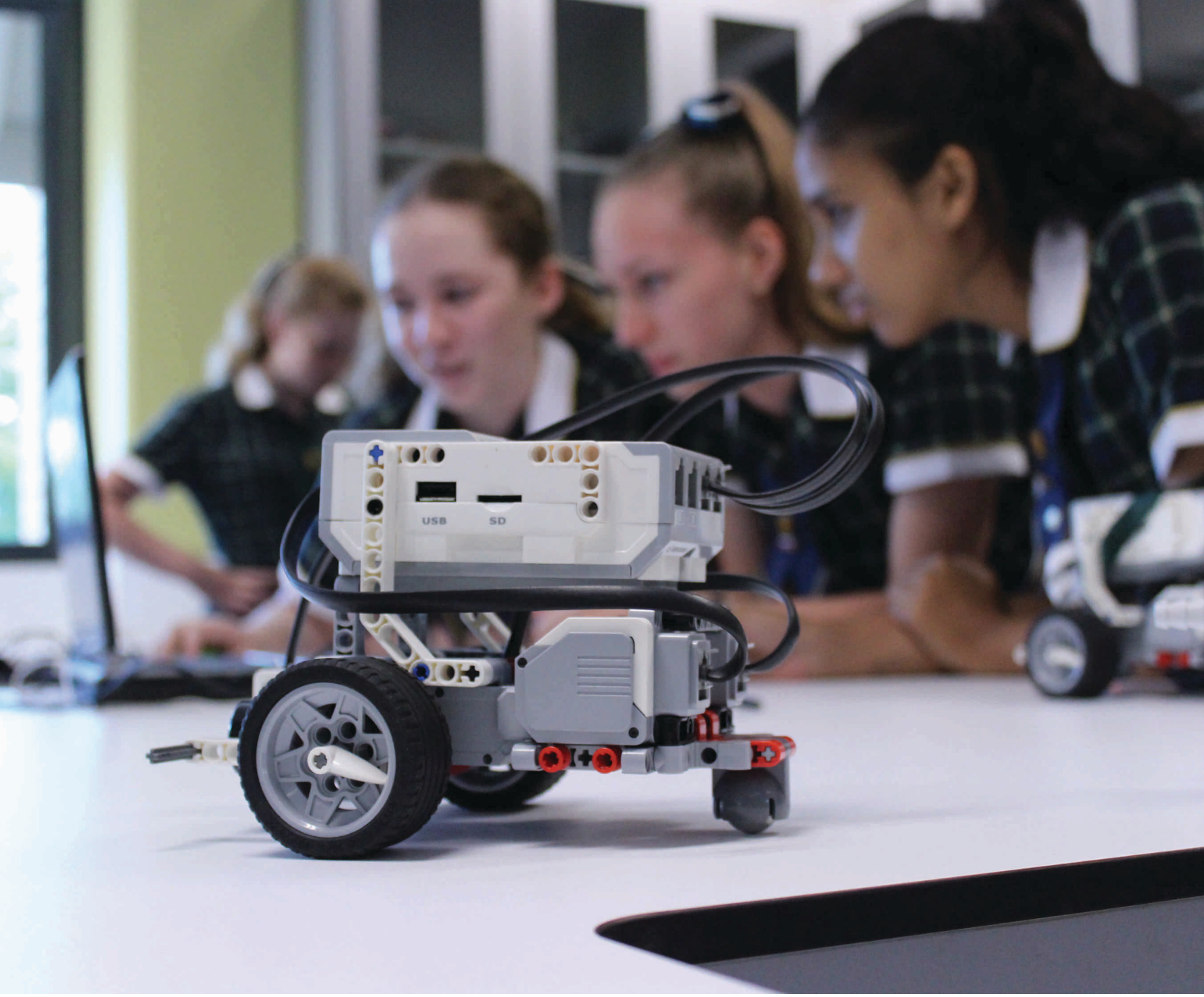
Laptop & Desktop apps

iPad apps



Links for teachers

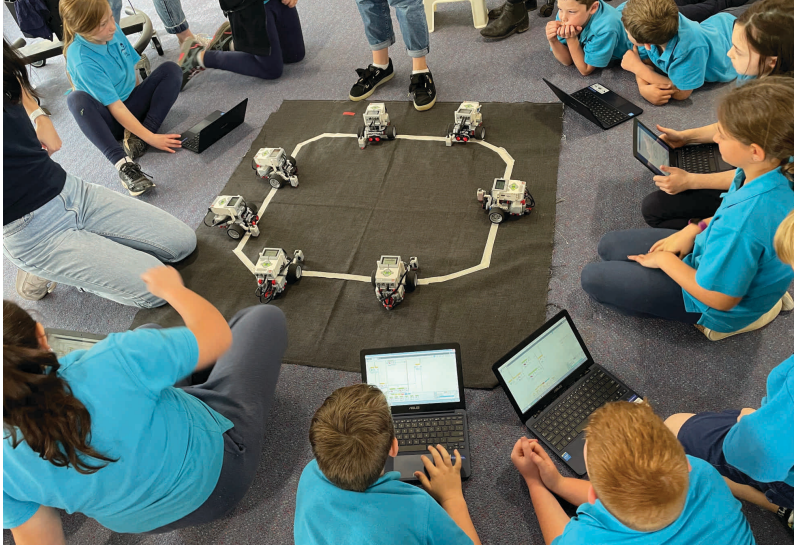
Join the **Adobe Creative Educator Program** via: http://adobe.ly/ACE | Watch the **Inject Creativity Live show** via: https://adobe.ly/injectcreativitylive | **Contact** the Adobe Education Team via: https://adobe.ly/contact-edu-apac



Robogal to Inspire STEM Edu

Miranda Ge

My name is Miranda and I'm an engineering education focused PhD candidate, with a background in Electrical and Computer Systems Engineering. Aside from my PhD, I work as a teaching associate for ENG1002, research assistant for Laureate Professor Marilyn Fleer's Conceptual Playworld and an outreach coordinator for Robogals.



Think back to your childhood, do you remember being asked "what do you want to be when you grow up?" Maybe you answered a doctor, teacher, movie star, athlete or many others! Out of these popular career choices, rarely do we hear an engineer, let alone a particular type of engineer. Did you know what engineers did exactly or about the variety of engineering disciplines?

Historic and recent trends indicate that there is a decline in the number of Australian students pursuing engineering careers, with this field also suffering from a lack of gender and ethnic diversity. An explanation, limited in the current landscape of work which has been conducted within this area, revolves around perceptions towards engineers and engineering. Perceptions are extremely powerful and influential in human thought and behaviour (Given, 2008). Perceptions towards particular subjects and careers are established early in the home and during primary school, guiding the selection of academic coursework throughout schooling and ultimately impacting career opportunities.

My research aims to gather a richer, more holistic understanding of children's, parents' and teachers' perceptions of engineers and engineering, which are important for the engagement of students in STEM subjects and ultimately, a career in engineering. Underpinned by the Social Cognitive Theory (SCT) as a theoretical framework, my research follows a sequential explanatory mixed methods approach, where a large-scale, cross-sectional study is currently being implemented, in which data is collected via two methods: self-completion questionnaire (quantitative) and semi-structured interview (qualitative). Findings from the main study will inform an intervention, to ascertain whether perceptions can be changed. The precarious position of this research during the COVID-19 pandemic has highlighted the need to embrace adaptability and transformation, such as adopting online data gathering techniques to perform successful research.

Implications leading from my research includes the implementation of findings towards targeted strategies, such as engineering-focused educational activities run by Robogals and the emergent area of elementary engineering. It is hoped that this combination can provide lasting engagement in engineering, ensuring the "E" in STEM does more than provide a vowel for the acronym (Symons et al., 2015). By crystalising what engineers do, what engineering is and transforming stereotypes, we may stimulate more exploration into the field, with young students possibly viewing it as a viable career option. A healthy and diverse STEM workforce could lead to new perspectives on innovation, creativity, leadership and success, ultimately impacting the world's performance and productivity.

If you are a parent or teacher of a Grades 4-6/Ages 9-12 child, our Monash Engineering and Education team invite you to complete and share this short, 10-minute survey on your ideas about engineers and engineering: bit.ly/surveyengineer. In appreciation, we will be offering $25 Coles Group & Myer gift cards for all interview participants and in a prize draw for survey participants.

The STEM community is making progress in many areas, such as outreach programs, in an effort to improve participation in engineering study and employment. Alongside my research, I am also an Outreach Coordinator for Robogals, a student run, global organisation, which aims to inspire students to pursue engineering and technology. Our mission is to "inspire, engage and empower young women into engineering and related fields". Our vision is "a global culture of inclusion and diversity in engineering". Our pillars, the fundamental values behind our mission statement and everyday activities are:

- Integrity: We are committed to our role in society and stand up for what we commit to achieve.
- Community: Robogals is a family. Whether you are an executive, volunteer, partner or supporter, we work together to make our vision a reality.
- Passion: We are dedicated to diversity and inclusion in engineering and related fields. We are determined to make a difference.
- Innovation: All members of our organisation have the chance to innovate and bring new ideas to the table. We encourage individualism and interests to shine.

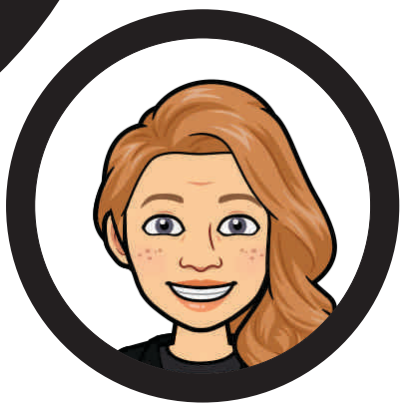
Our volunteers, all united under the cause of gender and ethnic diversity in engineering and technology run engaging, free-of-charge workshops to our local communities, ranging from primary to secondary school levels. Activities include programming Lego Mindstorms EV3 robots and JavaScript programming, both run face-to-face in addition to real-world case studies, run online. Along with our regular workshops, we offer a variety of outreach activities such as excursion, incursion and an upcoming mentoring program. If your school is interested in booking a workshop with us, please let me know!

References

Given, L. M. (2008). The SAGE encyclopedia of qualitative research methods (Vols. 1-0). Thousand Oaks, CA: SAGE Publications.

Symons, D., Jazby, D., Dunn, R., & Dawson, J. (2015). Australian primary students' perceptions of engineering. The Australasian Association for Engineering Education.

Girls in STEM



Alice Boxhall (she/her)

@sundress

Interviewed by Margaret Lawson, Our Lady of Sion College.

Now based in Sydney, I had the pleasure of chatting to Alice Boxhall, **Software Engineer** via Zoom about working in the tech industry and her transition from Year 12 Information, Professing and Management student to Google Software Engineer focusing on Accessibility and Web Standards.

I taught Alice back in the late 1990s at Methodist Ladies College in Kew and when I created an account on twitter many years later we reconnected through Donna Benjamin, a friend who was doing work with the Ada Lovelace Institute, where Alice served on their advisory board for a number of years.

Education

After high school, Alice completed a Bachelor of Software Engineering/Bachelor of Arts at the University of Melbourne in the 1990s. When talking about her degree, she mentioned that most of what she did was highly technical and focused on making software more efficient and faster to run. She had to have a basic understanding of hardware in order to do this, but her focus was on techniques for engineering software to do what she wanted it to do.

Alice studied mostly 'C', and later 'Java' throughout her degree. The emphasis was more on techniques and the theoretical background in programming rather than the specific languages. The idea that skills could be transferred to new languages was emphasised.

Alice mentioned that it was really important during her degree and in her eventual career to network with people working in the industry. She found it beneficial to find interest groups and meet them in person to build up her professional relationships. Of course technology has made networking easier in recent years with the invention of **LinkedIn** and **Twitter**, but it is the physical networking that has been important for her career development - and also her mental health.

She found that she loved accessibility, and learned that one area which can have an impact on the lives of people all over the world was to bring an accessibility focus to work on Web Standards - evolving the fundamental technologies people use to build web sites. The web is littered with articles and presentations that she had done over the years on this area of technology.

Working in technology means that you always need to update your skill set. In the course of working in industry for over 15 years, Alice has learned several new programming languages (some of which didn't even exist when she was first studying programming), as well as the complexities of working on projects which may contain millions of lines of code and have thousands of contributors at any point in time, and the specific skills involved in proposing and implementing new ideas in Web Standards.

When talking about her “next moves”, as she has now left Google, she mentioned the importance of maintaining her network contacts. Often job opportunities arise through colleagues who know what she is like as a software engineer, and see her as a good fit for their organisation.

Working in Assistive Technology

Post university, it took her eight years to discover this growing field of “accessibility and access”, but once she did she thoroughly enjoyed the opportunities that it presented her with. A period of time spent in Silicon Valley provided her with the opportunity to fully immerse herself in the culture of Google, and the broader tech industry. Despite the glitzy image of collegiality and technological innovation, the work environment is still “high pressure” with the expectation of “high performance”.

Alice has spent a large chunk of her career working at Google developing HTML to be more accessible to users with disabilities. I naively asked which version of HTML we were upto and was surprised to learn that HTML 5 is more of a “marketing term”, and HTML now has “living standards” and version numbers have little relevance. Once a feature has been developed and the browsers adopt it as a feature, it becomes part of the living standard.

Tech Industry Culture

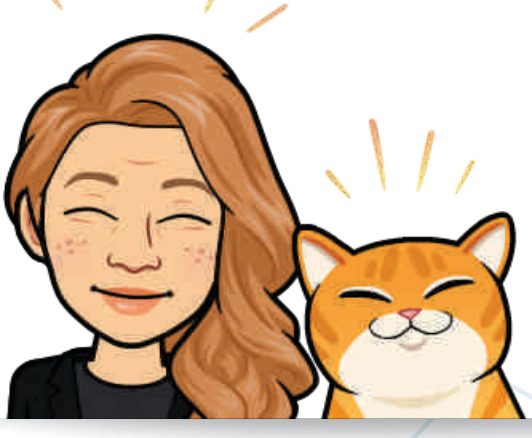
Alice mentioned that in one sense, the tech industry is still very “traditionally male” in the way in which they see and solve problems. Working in the area of accessibility, often challenges are seen as inconvenient problems rather than opportunities to improve the user experience for everyone. Alice likes to work with the “nothing about us, without us” mantra when working with the disability community, and tries as much as possible to help ensure that disabled people are included as equal participants in the process of creating technology. Creating software that is inclusive of everyone is more than just a “favour” that the software companies are performing, it is a human right. Inclusionary software is starting to become common business practice and she is proud that she has been a part of this journey.

Alice said that when looking for a career in tech, try to ignore the tech industry ideal of what “success” looks like. The “white male high flying venture capitalist multi-billionaire” image of Elon Musk and Zukerberg has done damage to the real impact that technology can make in

society. Consider finding a mentor and talking with them to try and come up with some goals for your career, even if they're very vague.

Depending on your goals, she mentioned that you might be happier looking for opportunities outside the traditional technology company for organisations that are trying to make a difference - even if those organisations don't promise “success” or “career advancement” in quite the same way. For example, she mentioned a friend that is currently working with a non-profit organisation looking at Bushfire data and how that can be used to improve response times in a bushfire emergency.

At this point in her career, Alice is focusing on her values and how technology can improve the lives of others. For her next jump, she is looking for a company who will make a difference not only in the community but also in the way that it takes care of its workers.



Tips and Hints

- It might take you a few years to find your niche but stay the course!
- Make sure you network, physically if possible, with other people in the tech industry. Keep those networks alive with Twitter and Linkedin, and look for local meet-ups in your area. Where (and when) possible, attend conferences - be on the lookout for scholarships which can cover travel, accommodation and conference fees for early-career engineers.
- Prepare to be seen! Don't underestimate the power of stepping up to speak or help run an event - often speakers and volunteers will network among each other, and it can be a less overwhelming way to meet people in the field.
- Who are the movers and shakers in the area that you are interested in? Technology gives us the opportunity to access their thoughts across a variety of modes, from Tweets to full-length talks.
- Embrace every opportunity; the tech industry is global so you might have to travel overseas to build up your expertise.

Want to learn more?

- **Web Accessibility** by Google Developing with Empathy (with Alice Boxhall) **https://www.udacity.com/course/web-accessibility--ud891**

- Podcast: S04E07 - **Accessibility** with Rob Dodson and Alice Boxhall **https://modernweb.podbean.com/e/mw-s04e07/**

- **HTML Living Standard**
  https://html.spec.whatwg.org/multipage/

Diversity means more than Girls

By Dr Linda McIver

Author of Raising Heretics
and Executive Director of ADSEI

Some years ago, at a reunion with some old friends, one of their children came charging up to me and said, in a most outraged voice, "Your son thinks he's a girl!" I laughed and said "My son IS a girl." Which made his little brain explode. He was confused because Sol had short hair and was wearing trousers, which did not fit with his internal image of a girl. But that conversation looks a little different now, since a few months later, when Sol was 10, they came out to us as non binary. This means they don't identify as male or female, and being misgendered – ie identified as male or as female – is really traumatic for them.

More and more young people are identifying as gender queer or non binary, and because I write about it a lot, and advocate fiercely, people tend to talk to me about it. And every time I talk or write about it, more people contact me, relating to the topic. This is not contagion. This is empowerment. As there's more representation, more kids feel safe to come out.

But this is not a chat about my family, this is supposed to be an article about Data Science Education. So why am I telling you this? Because all of the well intentioned Girls in STEM programmes out there are explicitly excluding a rapidly increasing and already marginalised group. Non-binary and gender queer kids often have to fight simply to identify as themselves. They have to carve out a safe space in their families, in their schools, in their social lives. Asking them to choose a programme for girls, or, indeed, one for boys, is either directly causing them trauma, or explicitly excluding them.

The other reason that Girls in STEM programmes are a problem is that women are only the obvious part of our diversity problem. By trying to build the number of women and girls in STEM, we are only tackling the easy part – though it's not that easy, judging by the sheer volume of women in STEM programmes and the persistently stubborn failure of the numbers to actually shift.

A problem is that we consistently attract the kinds of people to tech that we already have. We are missing big chunks of the population, including boys, who don't see themselves as nerdy, who don't see the point of tech. Girls who don't see the relevance. Non binary and gender queer kids who don't see themselves as represented or welcome in any of the tech programmes available to them.

If we had true diversity in technology and data science, we'd have a range of ethnic & cultural backgrounds, as well as people with a wide range of physical abilities. We'd have people on our design teams that are mobility compromised, vision impaired, with allergies, with varied gender identities and sexualities, with every possible skin tone and body shape. We'd have people who act differently, dress differently, think differently, and have different needs… I have headphones that don't work very well with long hair, for goodness' sake! Guess who was on that design team?

Fortunately, there are steps we can take…

When I was teaching and made the switch from teaching year 10 kids tech skills with toys to teaching them with data science, we not only doubled the girls in the elective year 11 computer science subject the following year, we also had a big jump in the number of boys who enrolled.

The key to encouraging a diverse range of people into STEM careers is kids learning that STEM skills are tools you can use to change the world. At ADSEI, we create projects and train teachers to empower kids to create change in their own communities. From five years old to 18 and beyond, we use STEM and data skills to create change.

And we do it as part of the core curriculum. STEM is not an elective, a one day incursion, or an extracurricular activity. Data literacy and STEM skills are something everyone needs in order to make sense of our rapidly changing, crisis-ridden world. We need to teach our kids to be critical data thinkers.

The huge advantage of using authentic problem solving to teach STEM skills is that there is no right answer. Students can't check their results in the back of the textbook, or take it to teachers to get it marked right or wrong. Instead they need to critically evaluate their own work, figuring out where their solutions work, and where they don't. Asking questions like "Who is helped by this solution? Who is harmed by it? How is it flawed? How can it be better?" Imagine if questions like those were routinely asked in business and government!

When you use real data, you also have to ask what's wrong with your dataset. Real data is never perfect. Unlike textbook datasets that produce perfect curves, real datasets have outliers, flaws, and complexity. They are messy and complicated. Like the election dataset I used with my year 10s for our first foray into data science. Students analysed a file that contained every single vote cast for the senate in Victoria in the 2016 Federal election. Once we explained the voting rules to them, they figured it would be safe to assume that every vote would only use each number once, people would vote below the line or above it, but not both, etc. In other words, they assumed that people reliably followed the rules. This, of course, is not how people work! It was wonderful, because it meant that the students had to assume that the data was broken, and take that into account when they wrote code to analyse it - just like in the real world!

The more kids learn data science and STEM skills as tools to change the world, the more they believe they can do it, and know that it's worth doing, and the more diverse our STEM workforce will become.

Dr Linda McIver is the author of *Raising Heretics: Teaching Kids to Change the World*, and the Founder and Executive Director of The Australian Data Science Education Institute (ADSEI), a charity dedicated to empowering all kids to change the world with STEM and Data Science skills. You can access ADSEI resources at adsei.org, including lesson plans, project ideas, blog posts, and interesting datasets.

Victorian Coding Challenge

Stage 2 Competition Winners

NOTE: This article is about the 2020 Victorian Coding Challenge. Winners of the 2021 Victorian Coding Challenge have been announced and an article will be published in an upcoming edition of DLTV's fortnightly newsletter.

The Victorian Coding Challenge was part of the Victorian Challenge and Enrichment Series funded by the Victorian Department of Education and Training. This report was adapted from the one shared by DLTV and MAV at https://www.mav.vic.edu.au

MAV, in collaboration with Digital Learning and Teaching Victoria (DLTV), announced the winners of the 2020 Victorian Coding Challenge (VCC).

We have been extremely impressed with the level of engagement and participation in the VCC. Over 3000 students from government schools across Year 5-10 took part. The feedback we have received from teachers and students alike has been wonderful, and we look forward to next year's VCC.

We received many entries for the competition, and we would like to thank all our volunteer judges who helped with the first round of judging. The final expert judging panel had a really fun (and extremely tough) job this week going through all the entries in order to try to identify the top 3. In some cases, that choice was almost an impossible one.

In many cases, there were only very small details that put certain teams on the podium above others. So we'd like to congratulate all the students on their work. They should be very proud of their achievements, regardless of if they've received a prize or not.

The following students produced work that was way above our expectations. What incredible minds are out there! Students will receive a prize voucher (which will be sent to their teacher to distribute). We hope they enjoy this well-earned award over the summer holidays!

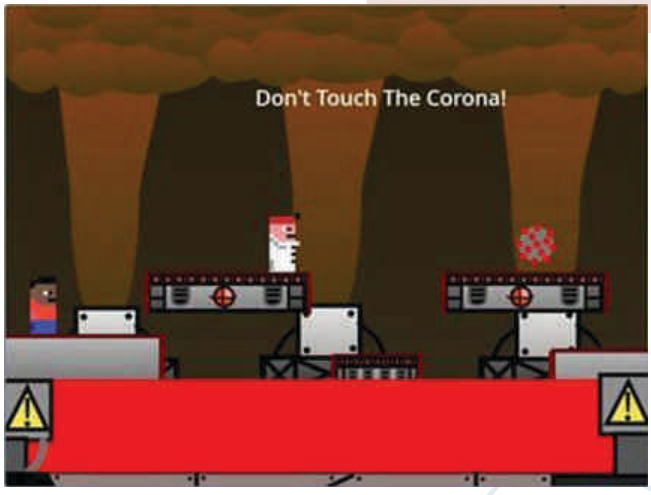
Judges' Comments for Year 5 & 6

The Year 5 & 6 competition prompt was to develop a cooperative game where two players have to work together to solve a problem around the theme of isolation and finding their friends.

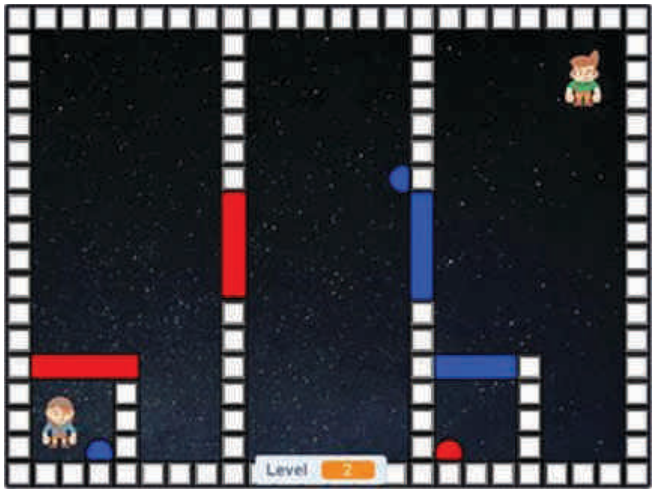
Many of the entries exceeded our expectations, and we were particularly impressed by the teamwork clearly demonstrated in many of the submitted videos. Well done to all participants!

As judges, we had several top games from which to choose winners.

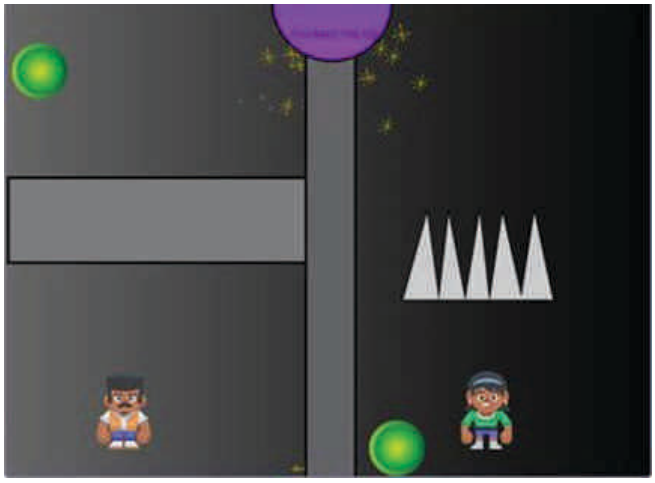
1st Place goes to Jacob, Maxwell and Max from Knox Gardens Primary School, who developed a multi-level game that required unique cooperation and defeating a sophisticated enemy.



Equal 2nd Place goes to Viha and Andrew from Moorabbin Primary School for the best puzzle design and a clever level generation algorithm.



And Equal 2nd place also goes to Samuel and Hugo from Merri Creek Primary School for a solid cooperative experience and clear demonstration of teamwork.



3rd Place goes to Lucas, Hosanna and Alana from Oak Park Primary School for a strong story with connection to the prompt theme, varied levels and unique adventure elements.

We have two Special Mentions from the Year 5&6 category:

- Cooper and James from Croydon Hills Primary School developed a solid game on theme.
- Lily, Eve and Blake from Tecoma Primary School combined elaborate cutscenes and story with a cooperative platform core.

Judges' Comments for Year 7 & 8

The Year 7 & 8 competition prompt was to develop a recommendation chatbot to determine an ideal travel destination, career/subject or animal based on the user's responses to a series of questions, including the use of sentiment analysis.

We greatly appreciate the effort put in by all teams in their videos and completed programs. All the entries were working programs that we were able to test. Well done!

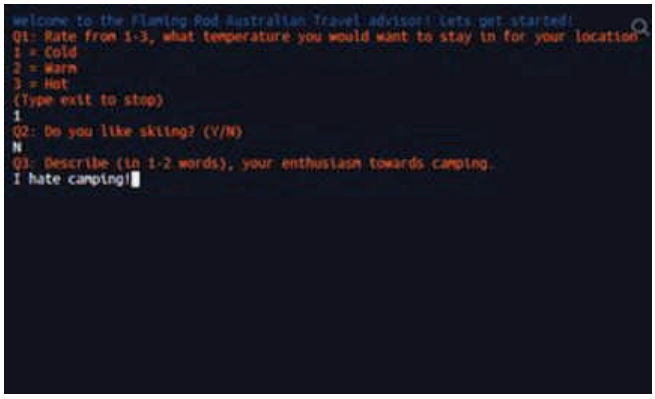
As judges, we attempted to strike a balance between solutions that covered the basic functionality well, and solutions that included clever, innovative features.

The winning entries all responded to the prompt with an emphasis on communicating with the user in a human-like way, including some amount of input validation.

1st place goes to Dylan and Mike from St Helena Secondary College. This entry stood out with a PDF format report produced from each interview listing the statistics for the final decision and a blurb about the recommended holiday destination.

2nd place goes to a team of students from Sunbury Downs College. This entry was deemed to have the most "human-like" interaction, with extra effort put into input validation.

3rd place was awarded to Nikolaos and Matthew from Mount Erin College. The judges appreciated this team's alternative approach and their video's demonstration of design work.



Judges' Comments for Year 9 & 10

The Year 9 & 10 competition prompt was to extract information from Wikipedia to identify information such as the profession and age of a given sportsperson, politician or scientist. Solutions were also required to produce a poem or quiz about the given person or people.

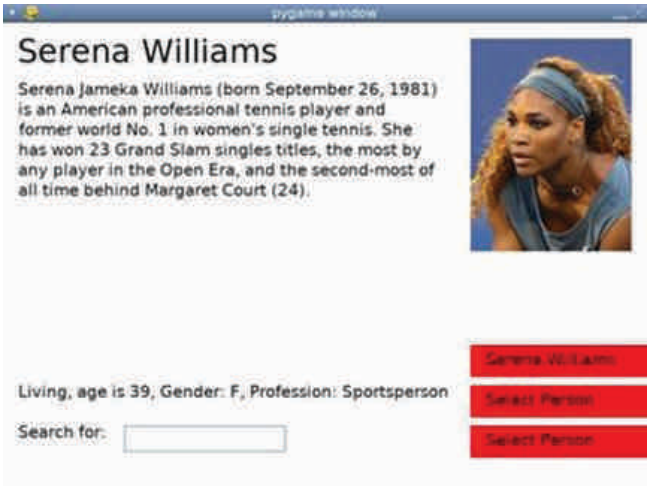
The judging team were delighted with the quality of the entries overall. Almost every submitted solution meets the core functional requirements. Many go well beyond the basics with graphical user interfaces or clever quiz designs based on the information extracted from Wikipedia.

Most teams also produced excellent videos communicating their designs and code, which was especially pleasing.

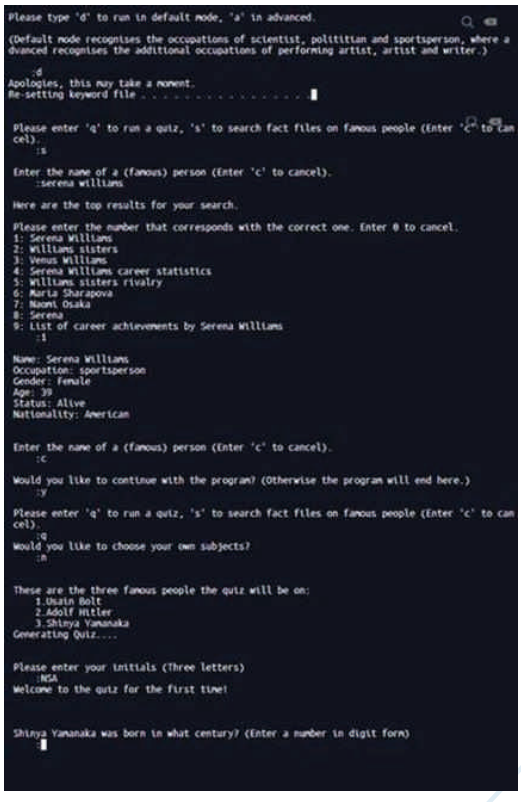
As judges, we had a difficult challenge to choose three winning entries, with several others very close to the podium. This year, we decided to split the First Place award three ways, rather than award Second and Third Place awards.

The three winning entries each have stand-out features, whether doing poetry or a quiz.

One of the Equal 1st place awards goes to Jaylen, Sanjay and Alexander from Melbourne High School. This winning entry combines excellent, clean code organisation with a graphical user interface.



Another Equal 1st place winning team was Keren and Henry from Swifts Creek P-12 School. This project stood out due to its dynamically generated data sources and legacy score-keeping.



And last but by no means least, our third team awarded the Equal 1st prize was Xavier and Alessandro from Brunswick Secondary College. Their end result is a highly customisable program, generating unique poetry.

Finally, we have three Special Mentions from the Year 9&10 category:

- Rutav and Dhruv from Mount Alexander College for great presentation and surprisingly compact code.
- Nam and Kevin from McKinnon Secondary College for advanced coding techniques and organisation, and a unique approach to the quiz.
- A team from Sunbury Downs College for more than covering the functional requirements, as well as incorporating a graphical user interface.

```
Victorian coding challenge: Wikipedia based data extraction and poem generation

If program is loading for a long time, try pressing any key

Following input must be either U (user provided name), r (required names), s
(suggested names), or h (help and additional information)

What people should the script be run with?:
Poem settings (h for help, d for default):

Poem settings to be used:
Poem order: normal
AI fill: True
Set poem order: aaaabbcc
Number of words: 10
Words to generate: 10
Number of syllables: 2

Please type a name: JFK

Name: John F Kennedy
URL: https://en.wikipedia.org/wiki/John_F._Kennedy
Birthday: 29/05/1917
Age at death: 46
Career: Politician
Gender: Male

abba
Poem: (199 words long)

John F Kennedy was a hugely awesome politician
Owning vast amounts of paragon, polygon, and rapprochement,
He lived to 46 years old and was hugely disposition
His awesomeness was admired by many, his propositionness as well
Some say that John would sometimes go and get a attrition, sedition, and
definition
John F. may have owned a rpf
His large collection of things included a profoundly deaf, a hfdf, a alto clef,
and a tenor clef
F Kennedy was born in nineteen seventeen
His birth was awesome, not mentioning the byzantine

He lived to 76 years old and had less than 1 percent
His capacity was enormous with a vast collection of felu familes, his hubris as
well
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Designing and developing a web-based virtual laboratory for the concept of blood types

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Introduction

Laboratory experience is a crucial element of science subjects. However, there are some problems in conducting laboratory activities. The first problem is the lack of resources for laboratory activities because some laboratory tools are too expensive (Chala, 2019). The second problem is that there might be safety and ethical issues surrounding laboratory activities. For example, Mims (2013) reports that laboratory activities in the concept of blood types that require the use of lancing needles to extract blood might cause blood-borne pathogens. She also states that this activity has ethical issues as there are students who do not want other people to know their blood types (Mims, 2013). Therefore, there is a need to overcome those problems by providing a learning resource to facilitate students in conducting laboratory activities safely. Based on those problems, this project aims to design and develop a web-based virtual laboratory for the concept of blood types. This paper will explain the literature around virtual laboratories, the design and development process, the justification of the final product, the ways to manage cognitive loads, and the evaluation of the final product.

Literature Review

Definition of Virtual Laboratories

Babateen (2011) defines virtual laboratories as "virtual studying and learning environment that simulate the real lab. It provides the students with tools, materials and lab sets on computer in order to perform experiments subjectively or within a group at anywhere and anytime. These experiments are saved on CDs or on website" (p. 101). In addition, Ahmed and Hasegawa (2014) divide virtual laboratories into Online Virtual Laboratories (OVLs) which refer to virtual laboratories in the form of a website to be accessed through the internet, and Computer-based Virtual Laboratories which refer to a virtual laboratory program that has to be installed in computers.

The Benefits and Limitations of Using Virtual Laboratories

The use of virtual laboratories as an educational tool is considered beneficial for some aspects. Firstly, virtual laboratories can increase students' learning outcomes, engagement and motivation. It can be seen from some studies that have proven the positive effect of virtual laboratories on these aspects. For example, Radhamani et al. (2014) provide empirical evidence that students' learning outcomes increased after using a virtual laboratory in a Biotechnology course. Then, a study by Kamtor (2016) shows that the use of virtual laboratories could improve students' engagement and motivation. Another example can be seen in a study by Chang, Lin, Wang, Cheng, and Chiang (2021) comparing both virtual and traditional laboratories in the dental education field. It proves that virtual laboratories are more effective than traditional laboratories, which can be seen in the difference in students' learning outcomes and diagnosis ability from both methods.

There are also educational benefits of using virtual laboratories for other aspects. For example, virtual laboratories can be used remotely regardless of geographical constraints (Lynch & Ghergulescu, 2017). Then, using virtual laboratories to conduct experiments requires a relatively short amount of time (Caño de las Heras et al., 2021). Moreover, a study by Bortnik, Stozhko, Pervukhina, Tchernysheva, and Belysheva

(2017) shows that the use of virtual laboratories can improve students' research skills which can be seen from their ability in writing research reports. In relation to this, using virtual laboratories as learning tools can also stimulate data analysis skills and help students design and perform experiments systematically (Seifan, Robertson, & Berenjian, 2020).

As educational tools, however, virtual laboratories are not perfect. There are some limitations to using this kind of technology. The first limitation is the lack of interaction and teamwork among students in a virtual laboratory environment (Babateen, 2011; Chan & Fok, 2009). Then, some traditional laboratory work elements such as uncertainty, varying observations, and findings cannot be observed in virtual laboratories (Scheckler, 2003).

Design and Development Processes

There are several steps in designing and developing the web-based virtual laboratory that will be explained below.

Determining Virtual Laboratory Platform

In order to develop a virtual laboratory that can be accessed online, it is necessary to choose the right platform. In the beginning, I intended to develop a virtual laboratory in *Flash* format. However, Adobe as the *Flash* provider, will not support this format anymore by the end of December 2020 (Adobe, 2020). Therefore, I decided to develop a virtual laboratory in HTML5 format which can be accessed through desktop, tablet or mobile browsers.

Determining Virtual Laboratory Components

Some components below will be included as the components of the web-based virtual laboratory:

a. Learning Objectives

This component allows students to know what should they acquire at the end of learning through the virtual laboratory.

b. Storyline

This component will be in the form of a story about a certain circumstance which can be an initial prompt to introduce the concept of blood types. The use of a storyline may sustain students engagement by providing clear objectives and pathways of what students should do in the virtual laboratory (Novak, 2015).

c. Theoretical Explanation

This component provides an explanation of the blood typing concept that will be simulated in the virtual laboratory. The theoretical explanation is beneficial to give scaffolding for the users (Jumaat & Tasir, 2014).

d. Procedure

This component contains the sequence to conduct a simulation in the virtual laboratory.

e. Interactive Simulation

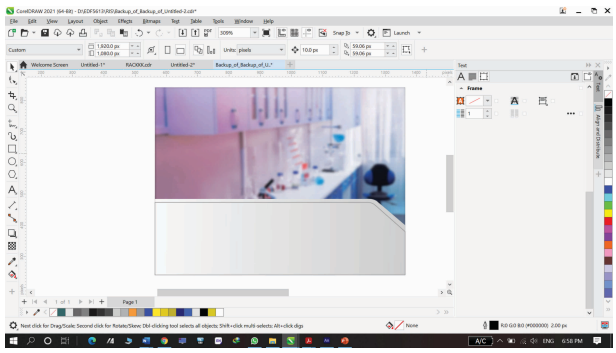
This component represents a real laboratory environment that allows students to conduct practical work.

f. Assessment

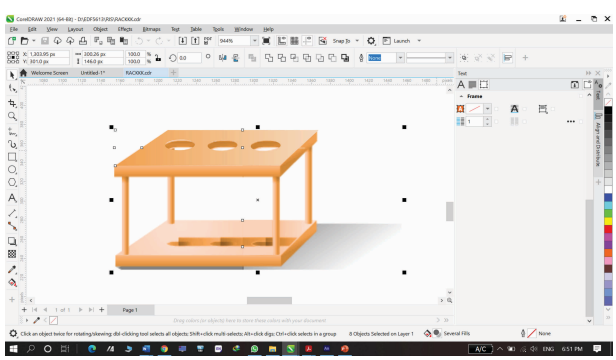
This component contains questions to confirm students' understanding of the concepts and the achievement of learning objectives. In this project, a formative assessment with no grade was used. According to Hattie and Timperley (2007), providing feedback is more effective than providing grades. Moreover, the assessment can be a documentation of how well students' understanding of the concept of blood types. It also provides a record of students' observations in the virtual laboratory. Therefore, it is possible to give feedback to students based on that record.

Designing and Developing Virtual Laboratory

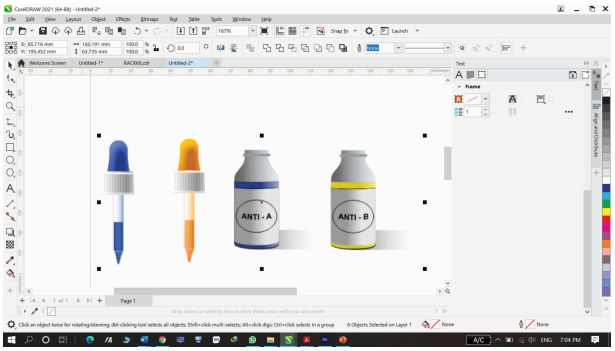
It is argued that the virtual environment should represent the physical and conceptual properties of the real-world environment because it can improve students' engagement (Choi et al., 2017). Therefore, in designing the virtual laboratory components, I tried to imitate the real laboratory tools. First, I used Corel Draw software to design the components of the virtual laboratory.



Designing Laboratory Table and Background

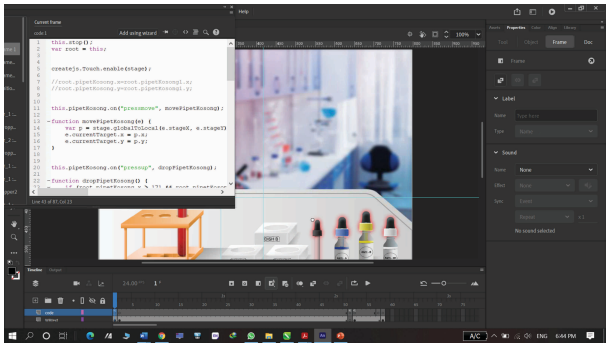


Designing Rack



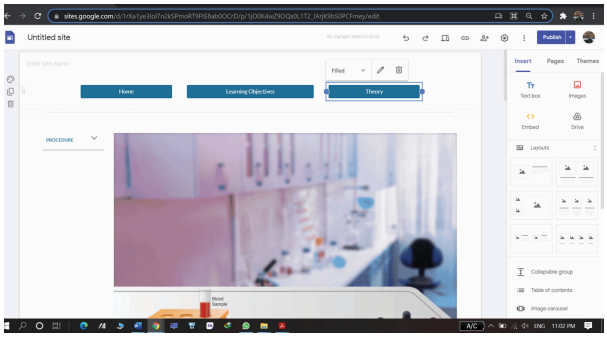
Designing Antiserum Bottles

Then, I added interactivity features by adding buttons, allowing drag and drop of the components, and adding animations. This process was done using Adobe Animate software with Javascript language.



Designing and Developing Virtual Laboratory Components

The next step was building and hosting the final product as a whole website. I used Google Sites as a web builder to host the final product and make web pages containing the written components, such as learning objectives and theory.



Building the Website Using Google Sites

The next step was building and hosting the final product as a whole website. I used Google Sites as a web builder to host the final product and make web pages containing the written components, such as learning objectives and theory.

The Final Product

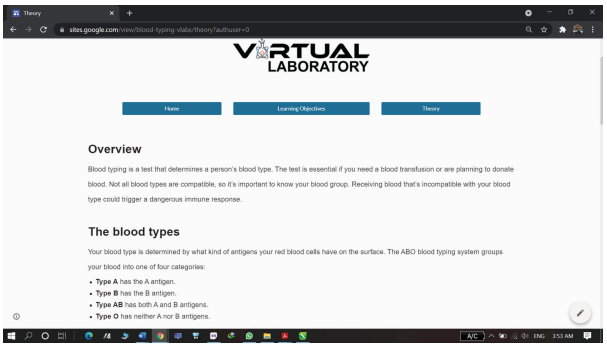
The final product was a website that included a combination of the virtual simulation and written components. This section will explain the justification of the final product based on some design principles.

Usability

The usability of a website is determined by how easily people access and interact with the contents (Andy, 2019). In order to improve usability, Nielsen (1997) suggest employing concise, scannable and objective texts of written components in a website. Therefore, I applied this principle to the written components in the website, such as in the theoretical explanation page, by dividing texts into subheadings, making bulleted lists, and providing the most important information at the beginning which is called the inverted pyramid (Nielsen, 1997).

White Spaces

Providing white spaces can make the contents readable and attractive (Gutierrez, 2014). In this project, I provided spaces between paragraphs and used proper spacing between lines in the written components.



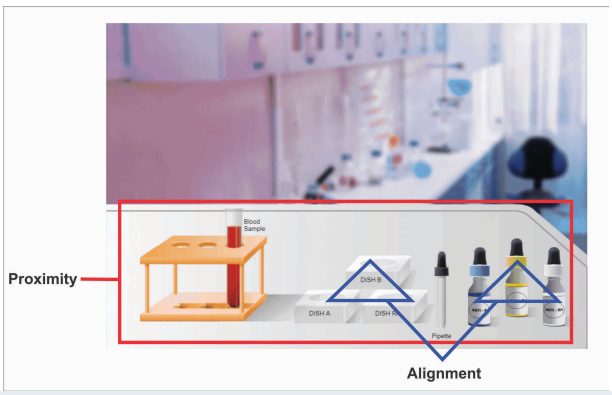
Usability and White Spaces

Proximity

According to the proximity principle, the related elements need to be grouped together (Henderson & Henderson, 2006). Therefore, I grouped related objects of the virtual laboratory in one position. For example, I placed the graphics of anti-serum bottles, the blood sample, and dishes in the same position.

Alignment

According to the alignment principle, "nothing should be placed on the page arbitrarily. Every item should have a visual connection with something else on the page" (Williams, 1994, p. 27). In the final product, some virtual laboratory components are aligned together following triangle lines to make a visual connection.



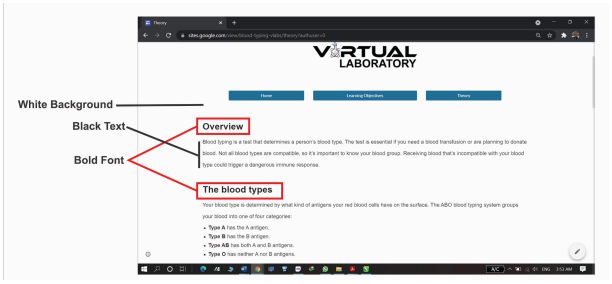
Proximity and Alignment

Repetition

Repetition can give a sense of continuity and consistency which can make contents more organised and easily recognised (Bear, 2020). In the final product, the repetition principle was applied in some components. For example, it can be seen from the use of the same bold font in the heading of the written components in the theoretical explanation page. I also used the same shape and colour for menu buttons.

Contrast

Contrasting different elements will make certain parts stand out and create a sense of greater importance and create better readability (The Principles of Design, 2020). I applied this principle by contrasting the colour of the written components with their backgrounds. The colours that I used were black for texts and white for backgrounds.



Repetition and Contrast

Managing Cognitive Load

Cognitive load is the amount of information that needs to be processed at the same time (Ayoob, 2020). Therefore, it is necessary to manage the cognitive load to ensure that information can be understood appropriately. In order to manage cognitive load, there were two ways I have applied that will be explained in the following sections.

Minimising Split Attention

Split attention is one of the factors that can increase cognitive load. It occurs when multimedia users have to split their focus between two or more information sources, such as between texts and images (Dixon, Terton, & Greenaway, 2018). In this project, the virtual simulation also includes both images and texts. In order to minimise split attention, I placed images and texts which have related information in a close position. It is related to Ayres and Sweller (2005) who state that physical integration of objects will reduce mental integration and keep the extraneous cognitive load to a minimum.

Minimising Split Attention

Minimising Redundancy

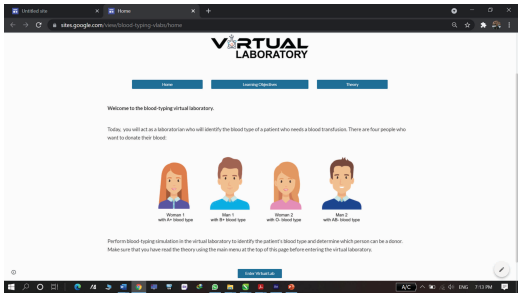
According to Sweller (2005), the transfer of information to long-term memory can be interfered by redundant information which can increase cognitive load. Therefore, in this project, I reduced the use of unimportant components such as decorating images and non-functional animations.

Evaluation

The following sections provide the evaluation of the final product.

Accessibility

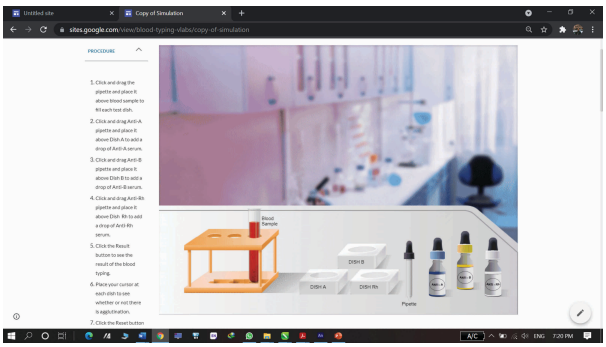
The final product can be accessed flawlessly through the website via computer, tablet or mobile browsers. The users can access the final product through https://sites.google.com/view/blood-typing-vlabs/home



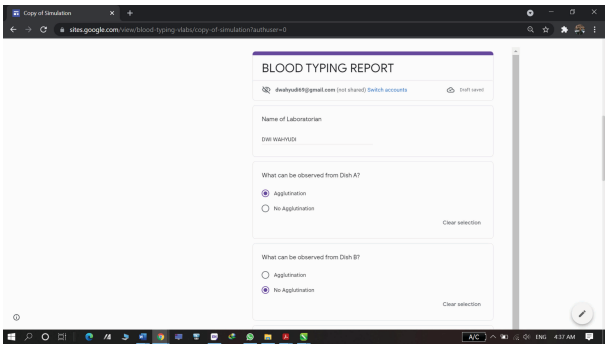
Home Page with Storyline

Functionality

The final product can be used to perform a laboratory simulation about the concept of blood types. In addition, the assessment component can also be used to produce a report. However, the final virtual laboratory product might lack experimental features as the users cannot choose different paths in the simulation due to the pre-defined simulation flows.



The Appearance of Virtual Simulation



The Appearance of Assessment Component

Interactivity

The interactivity components, such as navigation buttons and moveable objects, were well-functioning.

Aesthetics

The final product displayed the graphic of laboratory tools which represent the real laboratory tools. It was also built based on several design principles to ensure the appropriateness of its appearance. However, some components may lack contrast which can be seen on the graphic of the Anti-Rh bottle serum, dishes, and laboratory table that have a similar colour.

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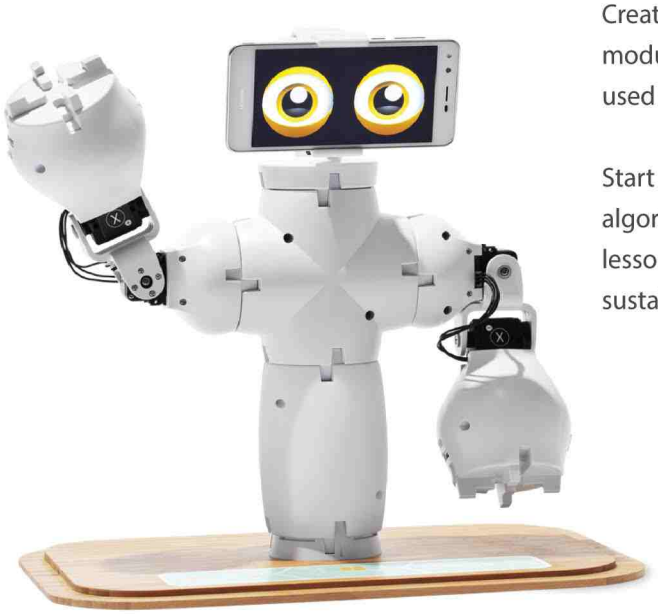
Introducing FABLE



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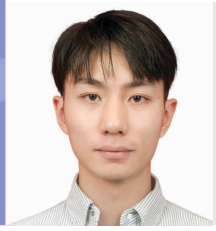
Enhancing Chinese characters learning activities in a MOOC with AR/VR

I am Hanshu Wang, a researcher from Monash University. My major is general education, and my interest field is particularly digital education, eLearning, and AI in education. Recently I am an intern in an artificial intelligence lab, which is more helpful for me to understand AI in education or digital education deeply.



I am Yiming Xue, a researcher from Monash University. I studied general education for my master degree. My interests are online learning, education democratization, and applying digital technology in education (especially AI). I have some experience in the research of these fields and some internships in educational institutions. Also, my expectation is shaping the digital future of education by AI technology.

Introduction

The Massive Open Online Courses (MOOCs) could be regarded as an innovative and advanced educational technology in the 21st century, and it also represents a new trend in education (Lin & Zhang, 2014). Development of the MOOCs based on the application of new digital technologies in education, including Information Technology, the Internet and Communication Technology, and Artificial Technology. This digital technology effectively prompted MOOCs to finalize its educational goal of spreading large amounts of information and knowledge openly and extensively to learners from distant corners all over the world. It is usually developed by some famous universities and well-designed by some experienced instructors, providing excellent online resources to support the self-learning of anybody at anytime and anywhere (Luaces et al., 2015).

From the beginning of the 21st century, the MOOCs have been through about 20 years` development, and it has achieved many successes in different educational settings. In 2001, UNESCO started a movement called Open Educational Resources (OER) to facilitate the spread of educational information. The participants, such as MIT, attempted to demonstrate their own educational resources online to learners without any limitation. It makes the OER movement the predecessor of the MOOCs, since then more and more teachers, learners, educators, and researchers put their focus on the MOOCs in the following decades. Some MOOCs` top providers such as MITx, edX, Udacity, Coursera, and Futurelearn barn one after another since 2011, which promoted MOOCs developed steeply. Therefore, The New York Times called 2012 as "the year of The MOOC". Till 2018, MOOCs had accommodated 100 million students, cooperated with over 900 universities, and provided 11.4 thousand courses (Shah, 2018). In 2020, a rapid ascent happened to MOOCs due the Covid-19 epidemic. UNESCO reports that on 1 April 2020, 185 countries had postponed schools and higher education facilities (HEIs), including 1,542,412,000 students, who make up 89.4% of enrolled students (Alsheikhidris, 2020). Facing problems like that, organizations and students are increasingly accepting MOOCs as a new normal of education.

Despite the successes made by MOOCs in the last 20 years, many challenges emerged during the implementation and practices of it. These challenges demonstrate in various aspects of MOOCs, our project pays attention to personal learning which is also one of the most important aspects in this field. After a large number of literature studies, we can conclude them into four main challenges, which are completion rate (dropout), assessment (feedback), plagiarism, and democratization. We also analysed the factors of each challenge, which could help us clearly elaborate the problems and provide designing solutions. First of all, the factors that result in low completion rate could be summarized into personal factors and course factors. On the one hand, personal motivation and attitude could affect the engagement of learners. On the other hand, low quality of courses could affect retention by decreasing the effects of

interaction. Secondly, peer assessment is a dominant form of feedback in MOOCs nowadays. However, its professionalism and credibility caused by the large number and unequal quality of MOOCs registers are doubted in personal learning. Moreover, democratization and plagiarism are two challenges that could not be neglected. Their factors (e.g. social background, educational prerequisite, technology, and instruction) are also important for our project.

Apart from the challenges of MOOCs, Chinese character learning is another significant area of this project. Different from the Germanic Languages, Chinese has a totally distinct language system, in which most of the Chinese characters are ideographs and their sounds are based on the letters in alphabetic languages. Therefore, in traditional Chinese learning, learners need to remember the structure and the order of strokes of Chinese characters first, followed by memorizing their sounds unconsciously. In this case, it is difficult for learners to find the relationship among strokes, meanings, and sounds of Chinese characters. That is also the most serious challenge for other language speakers, especially English, to learn Chinese. Recent years, due to the benefits of MOOCs and epidemic restriction, some Chinese courses are moving online, which means Chinese language learners are not only benefiting from this new learning form, but also challenged by both MOOCs and Chinese character learning itself.

Contextualizing in the challenges caused by the combination of MOOCs and Chinese character learning, Chinese language learners are ineffective in Chinese character learning MOOCs. Address the problem fixed, this project seeks help for Augmented Reality (AR) and Virtual Reality (VR). AR and VR are digital technologies developed in recent years, and also have potential to change the future. AR applies three-dimension technology in the real world by Object virtualization and Contextual Virtualization to enhance the users` motivation and interaction. Similarly, VR applies three-dimension technology in the virtual world to strengthen the learning environment, interest (motivation), and interaction. Based on these challenges and issues, especially those related to feedback and interaction, AR/VR may have the potential to solve the problem. To conclude, this project aims to explore enacting AR and VR technologies in Chinese character learning MOOCs, in order to facilitate Chinese language learners` effectiveness in personal learning. Furthermore, this project implements a design practice to solve the problems caused by MOOCs and Chinese character learning by applying AR/VR, and analyses their benefits to corresponding challenges (including motivation, interaction, learning environment, and feedback).

However, this project still has defects in some aspects of challenges to learners, such as guarantee democratization and avoiding plagiarism, they would even worsen to some extent, which would be elaborated in the design evaluation part. In general, this project could provide some support to future researches about moving Chinese learning into the MOOCs, and could attempt to experiment the application of AR and VR in educational settings.

Literature review

Chinese characters learning

Unlike English, most Chinese characters are ideographs. Letters in alphabetic languages represent sounds, while characters in ideographic languages represent meanings (Tse, Marton, Ki & Loh, 2006). This means, according to legend, Chinese characters were invented by a man named Cang Jie, an official during the time of the legendary Yellow Emperor Huangdi. The Yellow Emperor assigned Cangjie the task of recording and tracking livestock and grain, however, there were no words at that time and he could not write everything down. After much deliberation, he began to create symbols to represent different items (David, 2018). Visually, therefore, each Chinese character occupies an imaginary square space, and Chinese characters are also known for their ideographic origins (Tse et al., 2014). Then, people familiar with Chinese characters can sometimes guess their meaning from their component parts (Zhang, 1987, as cited in Tse et al., 2006). For example, "日"= sun and "月"= moon.

In this regard, since the structure of Chinese characters is very different from spelling words (Fan, 2003, as cited in Chen et al., 2013), learning Chinese characters starts with a clear understanding of their structural features is necessary (Tse et al., 2006). Chen et al. noted in 2013 that some researchers suggest that teachers use the character learning strategy of radical derivation to teach (Huang, 2006, as cited in Chen et al., 2013), as radicals are the smallest spelling units in Chinese character writing (Chen et al., 2013). Therefore, in traditional teaching methods, teachers usually follow a strict sequence, emphasising the order of strokes and the exact position of each stroke in Chinese characters (Taiwan Ministry of Education, 1996, as cited in Tse et al., 2006). Teachers insist that each student memorise each character correctly, and when the teacher writes the character on the board, they ask the students to imitate the teacher by writing the strokes in the air with their fingers and remembering their order (Tse et al., 2006). However, most learners find such manipulation difficult as there seems to be no relevant connection between the strokes and the meaning of the characters, and beginners find it difficult to remember the strokes in Chinese characters (Tse et al., 2006).

Current challenges on MOOCs

The first issue that MOOCs face is the completion rate, or in other words: the dropout, of the MOOCs, which is an essential challenge in this area. Former researchers have done many surveys to predict the completion rate, such as Koedinger et al. (2015). Results of the data survey demonstrated that of the 27,720 students who registered for the MOOCs at the beginning, only 4% of them finished the final exam. Barak et al. (2016) elaborated the relationship of completion rate with personal learning motivation, which indicated the dropout challenge is highly related to personal attitudes. The researchers also discussed drawbacks in course design. System quality, course quality, and service quality were significant antecedents of the

continuance intention of individuals, and the effects of course quality and service quality were mediated by perceived usefulness (Yang et al., 2017). The authors illuminated the results that low quality of courses would affect the effectiveness of interaction between teachers and learners, and form a low level of engagement and retention.

Secondly, researchers also paid attention to feedback and assessment of the MOOCs, such as Lucas et al. (2015) and Suen (2014). Revolving from this issue, these authors illustrated the challenges caused by feedback and assessment to personal learning, which made sense for our topic. Due to a large number of registers, MOOCs` feedback is always provided by computers such as quiz and choice questions or even no feedback (Lu et al., 2018). To solve these problems, many researchers supported using peer assessment in MOOCs` feedback, and the two articles mentioned above aimed to explore the challenges that peer assessment brought to personal learning. Luaces et al (2015) focused on the accuracy of peer assessment, supported the position that the professionalism of peer assessment is insufficient. And because of the low completion rate of the MOOCs, many researchers doubted if learners could receive feedback in time or even could they receive it at all, which was called credibility by Suen (2014).

Afterward, there exist other challenges of MOOCs that have been researched but not as common as the first two. On the one hand, Cheating is a reality in MOOCs (Pappano, 2012). Also, this challenge belongs to assessment issues, so its interactivity is concerned by researchers. Memon and Mavrinac (2020) elaborated that the ambiguous understanding of plagiarism, lack of methods and judgment of plagiarism-detection tools, and weak academic mentors are the factors that result in high plagiarism rate in the MOOCs, and they also put forward some suggestions to enhance interactivity between teachers and students such as managing and mentoring students away from plagiarism. On the other hand, Although MOOCs initially focus on realizing education equity by improving democratization in spreading information and knowledge to learners, some underprivileged learners are isolated from these education opportunities. Robinson et al. (2015) manifested that education context (e.g. bachelor's degree) is a significant prerequisite for MOOC students. Oudeweetering and Agirdag (2018) concluded factors that affect MOOCs` democratization into cost, language, culture, devices, and ICT accessibility.

MOOCs and Chinese characters learning

To combine MOOCs and language learning, interaction is the most important aspect needed to be concerned. As interaction is central to language learning (Lin & Zhang, 2014), from a sociocultural perspective, students need to acquire new forms of language through interaction with teachers and peers (Lantolf, 1994, as cited in Lin & Zhang, 2014). The MOOC has potential to make online language learning more meaningful if teachers can provide a workable structure for interaction and peer review on top of computer-based feedback (Lin & Zhang, 2014). Many researches aim to explore the interactivity in MOOCs that are beneficial for us to solve problems in the collaboration of MOOCs and language learning. For example, Jung (2019) elaborates on the theory of Connectivism in online learning and highlights the importance of autonomy, diversity, openness and interactivity in online learning (cMOOCs are a prime example). Many researchers also support our design around the relationship between interactivity and engagement in MOOCs. Baldwin and Ching (2017) analysed the characteristics of interactive storytelling (dynamic presentation, data visualisation, multisensory, interactivity and narrative) and explored the possibility of developing interactive storytelling to increase learner engagement. Besides, Koedinger et al. (2015) not only predicted the reasons for dropout but also proved that doing is much more effective than watching and reading in learning and raised learning-by-doing theory in online learning based on all these results.

Coupled with the fact that there is currently less research on Chinese learning than English learning on MOOC platforms, and that it has its own challenges in different aspects, such as completion rates, feedback mechanisms, and effective interaction. Recent years, some research revolving around the relationship between Chinese learning and MOOCs has emerged. For instance, Alsheikhidris (2020) did a study to explore the challenges of MOOCs to school courses and teaching through the analysis and discussion of online Chinese courses. High-quality direct use by Chinese instruction teachers, there are few materials, poor online effects, difficult to interact, and no language environment, the effect is difficult to continue (Alsheikhidris, 2020). Among these challenges, the author emphasized the importance of interacting and learning environment effects in Chinese MOOCs. However, researches focus on the special field: Chinese characters learning are still rare and undeveloped. Researchers need to conduct in-depth research and come up with corresponding design solutions to address them and push the development of the Chinese characters learning in MOOCs.

Potential opportunities of AR/VR

Currently, augmented reality (AR) and virtual reality (VR) are widely used as emerging technologies in education across a wide range of subjects (Huang, Zou, Cheng & Xie, 2021). Bensetti-Benbader and Brown specifically investigated the use of AR and VR in language acquisition and found that AR applications can enhance learning by promoting student motivation and interaction (Bensetti-Benbader & Brown, 2019, as cited in Huang, et al., 2021). Interaction is a key element of language learning, and through interaction with others, learners' motivation to learn a language can be enhanced. On the other hand, VR technology can also assist learning by providing learners with an immersive language learning environment (Bensetti-Benbader & Brown, 2019, as cited in Huang, et al., 2021). Moreover, Shadiev and Yang (2020) also argue that virtual reality has several benefits in language learning, such as visual support, enhanced interest in learning and authentic learning opportunities (Huang et al., 2021).

This design project also starts from this benefit, focusing on the different feelings that students get in the real world and the virtual world. Based on the definition of AR and VR in Figure 1, it is easy to see that AR is the collection of data from the real world through sensors that can be displayed as virtual elements after being analysed (Ardiny & Khanmirza, 2018). On the other hand, VR differs from AR in that what VR offers is to put the participants themselves in a realistic artificial environment, where they interact in a virtual environment with the aid of tools from multiple devices. Therefore, this project will also divide the learning content into a virtual part and a real part based on this feature.

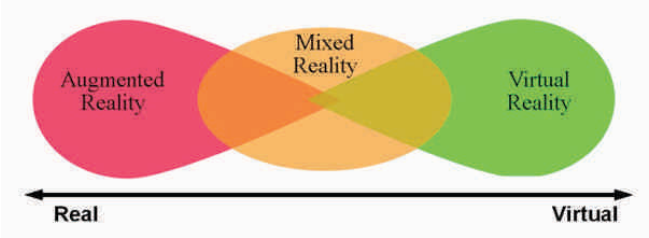


Figure 1. General representation for AR and VR classification (Ardiny, 2018)

Specifically, AR refers to three-dimensional (3D) technology that presents digital confidence in the real world (Abad-Segura et al., 2020, as cited in Huang et al., 2021). It can enhance users' visualization of the real world of virtual objects through graphical computing and object recognition technologies (Redondo et al., 2020, Huang et al., 2021). Chen et al. 2020 stated that AR has great potential in the field of language education because of its contextual visualization (i.e., presenting virtual information in a rich context) and learning interactivity (i.e., embodying interaction with virtual content) (Chen et al., 2020, as cited in Huang et al., 2021); VR refers to a 3D virtual world through which users can have a visual simulation experience through which users can feel that they are immersed in an environment without the constraints of time and space (Chang et al., 2020, as cited in Huang et al., 2021). Immersion and interactivity are considered to be core features of VR technology (Sampaio & Henriques, 2008, as cited in Chen et al., 2020). According to Vygotsky's sociocultural theory, people's interaction with the society and culture in which they live can drive them to shape their own intelligence (Vygotsky, 1978, as cited in Huang et al., 2021).

In Dale's cone of experience theory, students' learning experiences move from the bottom of the cone (learning through direct experimentation) to the top of the cone (learning through abstraction) (Dale, 1969, as cited in Ardiny & Khanmirza, 2018). In this regard, learners gradually reach the top by perceiving and understanding their new knowledge in real life through bottom-up learning situations (Ardiny & Khanmirza, 2018). Thus, AR and VR technologies have the potential to embed themselves in the lowest layer of the cone, enriching the learning environment and allowing students to immerse themselves in learning with the help of most of the five senses (Ardiny & Khanmirza, 2018). In this way, when students' motivation and interest in learning are enhanced, perhaps engagement rates will subsequently increase.

Design principles

Chinese characters learning principles

The goal of language learning is to ensure that students are able to demonstrate what they have learned, especially in the four main areas of listening, speaking, reading, and writing. Whereas vocabulary is the most basic structural element of a language, the amount of vocabulary determines the level and ability of students to use it (Zhang et al., 2021). For Chinese characters, as they are not phonetic, it is difficult for students to read the correct pronunciation literally and easily. They need to master the skills of 'listening' and 'speaking' through the study of *pinyin*, while the skills of 'reading' and 'writing' require the mastery of the most basic Chinese characters. The ability to read and write requires mastery of the most basic element of Chinese characters - vocabulary. This project is designed to help students grasp the origins of Chinese characters and how they change through the use of etymological associations so that they can master the use of the same type of Chinese characters.

Etymology is an effective method of teaching Chinese characters. It refers to a teaching method that follows the ancient idea of the original source of character creation, analyses the original source of character meaning (Zhang et al., 2021), and taps into the inherent characteristics and patterns of Chinese characters (Chen et al., 2013). In other words, modern Chinese characters are an exercise based on the process of creation and evolution of Chinese characters, with the original drawings of Chinese characters across time and space, enabling learners to influence their visual, auditory and thinking senses and remove their unfamiliarity with Chinese characters (Chen et al., 2013).

There is ample historical evidence that modern Chinese characters originated from pictures. In the process of creating Chinese characters, Chinese ancestors wrote on mountains and drew on water, creating primitive pictures based on their observations and experiences of the objective world, which were then refined to become the linear, symbolic characters they are today. The evolution of the script is as follows: primitive drawing - oracle bone script - gold script - seal script - official script - regular script.

For example, the characters for "fish" and "cow" are  , from the original drawings, a large fish or the horns of a cow. Therefore, using the etymology to show the process of the words change, adding the related story to students, could help them master the rules of the Chinese characters.

PARC principles

Proximity

The rule of proximity suggests that related items should be gathered together. For this project, the Chinese characters we have chosen are all hieroglyphs, which have the same origin and were transformed from the original pictorial script, so students can find patterns in these characters and identify the way in which such characters evolved.

Alignment

Williams proposed in 1993 to his principle referring to the fact that no content should be placed randomly on the page and that each item should be visually connected to the rest of the content on the page (Williams, 1993). We therefore designed the project with an eye to the invisible connections between the scattered elements of the virtual scene set by VR so that they were as unobtrusive as possible in terms of the student's vision.

Repetition

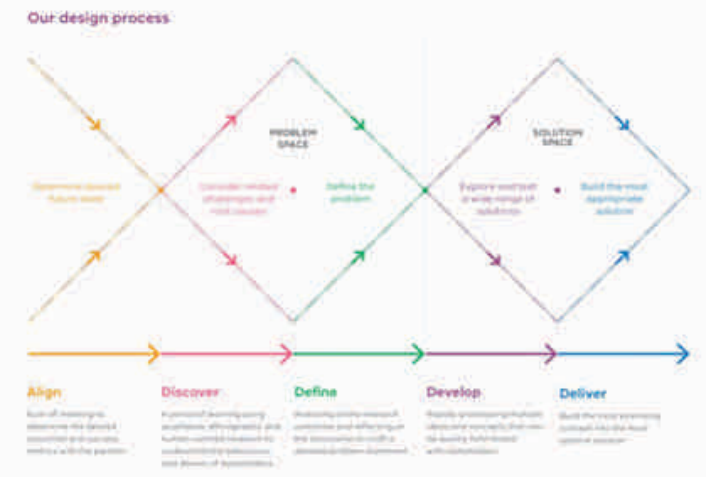
The principle of repetition states that certain aspects of the work should be repeated. The reader can relate the information in this form. In Chinese rhetorical techniques, repetition implies emphasis. This also suggests that when designing projects, we should be conscious of the repetition of key elements, which can be in the form of colours, animations, etc., in order to deepen the students' impressions.

Contrast

The principle of contrast proposed by Williams states that if two items are not exactly the same then make them different (Williams, 1993), which means using contrast to create focus. Chinese characters do not only have one type of hieroglyph, but other forms such as referential and rendition will also exist. The way they evolve differs from pictographs, so this can be added to the design, especially when doing post-learning exercises, so that students are not influenced by solidified thinking.

IDEO Human-Centred Design Model (HCD)

This approach, which is known as design thinking, brings together what is desirable from a human point of view with what is technologically feasible and economically viable. It also allows people who aren't trained as designers to use creative tools to address a vast range of challenges (Brown, 2020). The concept of HCD is defined as an approach to problem-solving that puts the people we are designing for at the heart of the process (Victorian Government, 2020). And there are mainly five processes for this model - i.e. align, discover, define, develop, and deliver.



Align

For the first process of this model, align the future state and desired outcome with the partner. We would first determine the project design conditions according to the influence of challenges caused by MOOCs and Chinese character learning.

Discover

Discover the behaviours and desires of stakeholders and consider the relevant challenges from different perspectives. This process would help us to understand the positions of teachers, students, policy-makers, and other educators.

Define

Define the challenges and provide a detailed problem statement. This process would offer a clear view to us of the challenges and their factors.

Develop

Subsequently, the following process is about problem-solving. Develop aims to prototype multiple ideas in a wide range of solutions. We would provide a large number of solutions that are associated with the challenges.

Deliver

Deliver concentrates on building the most promising concept into the most optional solution, which also focuses on problem-solving. In this process, We would analyse solutions demonstrated in the last process, and choose the most appropriate solutions to deal with the challenges.

Experiential learning principles

According to Kolb (1984), experiential learning consists of four elemental groups: concrete experience, observation and reflection, the formation of abstract concepts, and testing in new situations. He suggests that the learning process can begin with performing a specific action and then observing the effects of the action in that situation. A full understanding of the action in a particular situation is then followed by inferences about what would happen to the participants in a similar situation, and then the general principles of understanding the particular instance based on the above experiences are translated into real life. Our initial design of the project is also an attempt to bring students into experiential learning based on this principle. Learning Chinese characters can be difficult and boring for beginners, but this project will bring them into a virtual scenario, giving them visual stimulation of basic pictographs by stimulating them visually, they will grasp the patterns of evolution by observing such characters and then return to reality to trace them with the help of AR technology, translating the activities in the virtual experience into the general patterns of real-life and completing the learning the whole process of learning.

Design criteria

As noted above, the challenges our project faced derived from both MOOCs and Chinese character learning, and we could provide some solutions by applying AR and VR technology in our Chinese learning MOOCs. Constructing with some design

principles, such as language learning, Experiential learning, PARC, and HCD principle, our project attempts to solve the challenges in three main aspects: Personal Motivation, Interaction, and Feedback.

Personal Motivation

Personal Motivation, or in other words, personal interest presents learners` attitudes to a course, which is a significant factor for completion rate of MOOCs. To evaluate this issue, our project will use two methods to collect some data. On the one hand, we will provide a scoring panel at the end of each course, let students evaluate their own gains and interests according to this course, and score them from one to five by clicking a button. On the other hand, we will also count the completion rate of the entire series of courses, from the phased quizzes to the final exam. Exclude variables by filtering students with low scores on interests, and finally assess learners` personal motivation in our project.

Interaction

As an important factor affects both MOOCs and language learning, interaction is the most dispensable issue that needs to be evaluated in our project. Combining the two main challenges that learners face in Chinese character learning (understanding of relationship among Chinese characters` structures, meanings, and sounds; and practicing strokes of Chinese characters), we put forward two criteria to assess the effects of interaction in our project. Firstly, we will provide a small quiz at the end of each course to evaluate to what extent the learners understand every Chinese character taught in the course. Secondly, we will calculate the accurate rate that learners write each Chinese character, to assess whether they have written the strokes in correct order.

Feedback

Another challenge we attempt to provide solutions in this project is feedback. As mentioned above, in traditional MOOCs, there are two main forms of assessment: computer evaluated assessment and peer assessment. Both kinds of assessment are challenged when providing feedback. Our project aims to use teacher manual evaluation to offer feedback to learners` assessment, and also refer to criteria that the former two kinds of assessment used to evaluate the feedback. Therefore, we assess feedback in our project from three aspects: First of all, we will collect data of the quantity of feedback that teachers delivered and learners received from the course backstage, in order to understand the influence of the quantity of feedback. Moreover, our project tries to send feedback emails to learners to investigate the feedback provided by their teachers, and this email mainly consists of two issues: professionalism and credibility. We will ask learners to evaluate whether the feedback is useful for their Chinese character learning from which we could analyse the effects and quality of it. As for credibility, we will also require learners to reflect whether they have received feedback in time, and evaluate its timeliness.

Design choice

After a month of discussion, our design choices have been tentatively determined. Initially, once we realized the convenience that digital platforms offer to learners, we chose the MOOC as the platform to dissect its strengths and weaknesses. As stated in the previous literature review, the emergence of the MOOC does provide a wealth of resources for most learners and in some ways enables the sharing of knowledge. It has given learners freedom in terms of what they can learn, where they can learn and when they can learn. However, it must be admitted that some courses, especially those related to Chinese language learning, are less present in MOOCs. From what we know, although there are courses on Chinese character learning in MOOCs, they basically stay in the traditional teaching method of the teacher, and it is still challenging for beginners to grasp the rules and learn to use them. Furthermore, learning Chinese characters involves listening, speaking, reading and writing, and these four skills seem to be difficult to link for beginners. Furthermore, the majority of learning, both in Chinese characters and in other subjects on MOOCs, lacks interaction and monitoring mechanisms. There is no guarantee that students will always be self-disciplined in their self-study, so there is doubt as to whether learning outcomes on a MOOC are guaranteed.

So, in light of the above mentioned disadvantages such as the difficulty of learning Chinese and the lack of interaction on MOOCs, we have reflected on this. The current application of AR and VR in different scenarios in life caught our attention, such as VR fitting on mobile shopping software, or VR exploration for museum use, both of which solve the boredom and monotony of pure textual content. We started experimenting with combining AR and VR to piggyback on a MOOC platform for Chinese character learning. The initial plan was not perfect, even as we had to consider cost issues and feasibility. But after reading a lot of relevant literature, we decided to make some attempts.

Based on the above design principles, we will use the learning of simple pictographs such as "mountain", "water" as examples to illustrate the application of AR/VR in a MOOC in the following paragraphs. We have named this project the Immersive Chinese Character Learning Engagement System (ICLES), and seek to harness the strengths of new digital technologies to bring a different experience to students' learning.

Brainstorm ideas

During the brainstorming session, our initial design process was shown in the sketch below. Students claim the learning content for this session by logging into their MOOC account. Then, each lesson will have two modes for students to complete the process from learning to practice. First, students will need to select Mode 1, Virtual Experience, to enter into the experiential learning session. When the student looks up, he will see a mountain range and if he raises his finger to the mountain range, a sketch of a mountain will appear; if he points down to the river, a sketch of a river will appear. If he points down to the river, the river appears in the shape of "water". In this scene, he can touch his fingers to different things at will to get the shape of the corresponding thing. If he taps on a different shape, the oracle of the corresponding

object will pop up for him to identify. The story of how the character was created is also included below the oracle for the student to observe and reflect on.

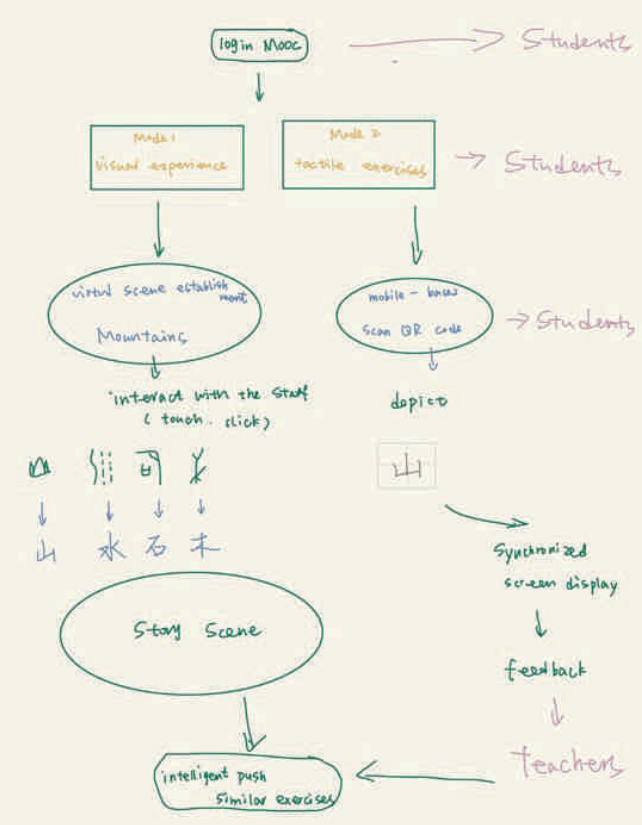
At the end of this experience, students need to exit Mode 1 and click into Mode 2 to learn the abstract concept. As the oracle shapes and occurrence stories of the different Chinese characters are already clear to the student through observation and interaction in the virtual scenario, this mode is designed to take the student out of the concrete experience and they can use their mobile phones to scan the QR code on the MOOC screen and proceed to the AR tracing process. As students trace the Chinese characters, the teacher can see what they are tracing simultaneously so that they can give timely feedback on what is right and wrong.

Once Mode 1 and Mode 2 are over and students have completed the experiential learning session, the teacher can then explain the course content based on their tracing and intelligently push out the same type of exercises for students to complete based on their error classification.

The below brainstorming session emphasizes student-led learning and experiential learning. We will then revise the sketches for any imperfections.

Our starting point in the brainstorming was to address the disadvantages of the current MOOC platform courses mentioned above, such as the lack of fun, interaction and feedback. Therefore, at the beginning of the design process, we had a number of discussions on the selection of virtual scenarios, and the key issue was how to present the different content in the selected scenarios. This was because, despite the large number of hieroglyphs, it was challenging to make connections between the selected scenes and the different texts. We had chosen scenes such as the sky and the sea, but ultimately chose the scene below because there were more elements that could be assembled in nature. For example, the sun, moon, mountains, rivers and fields. It made sense for these elements to appear in the same scene and they are also all pictograms, which was more in line with our design requirements for this project.

Design Sketching



Scene building

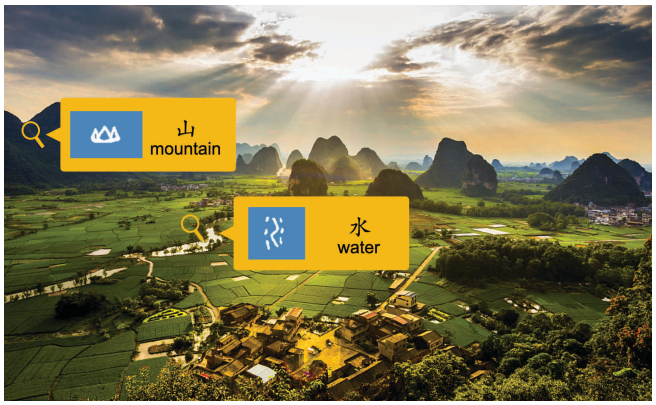
Color coding

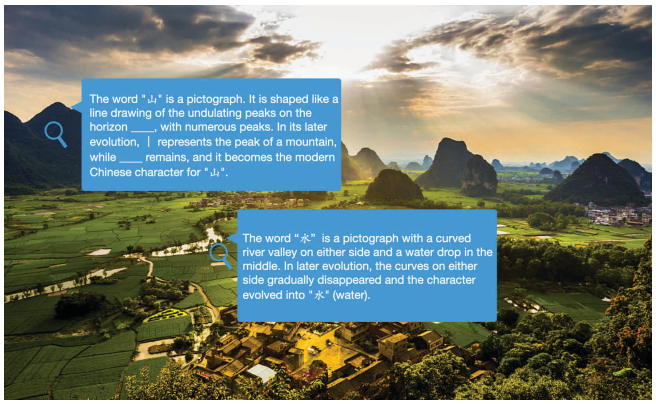
The Designer's Colour Guide 2016 states that yellow stimulates mental processes and activates memory ([INFOGRAPHIC]", 2016). The yellow symbol thus indicates that students can click in order to view the oracle shape of the thing.

Blue represents calm and soothing (Elrick, 2016), and in this project, the blue button indicates that students can click to see the corresponding backstory for the word.

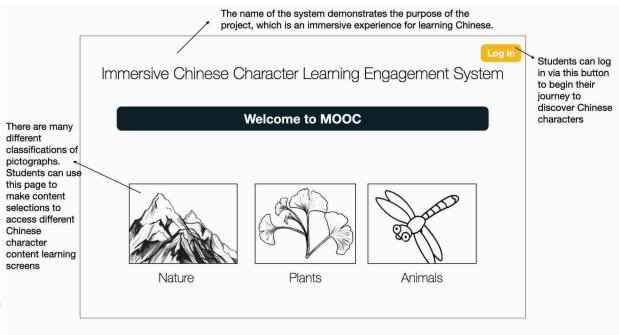
Elrick (2016) states that the red color indicates danger. In this scenario, the red icon represents that the word is easily confused or wrong.

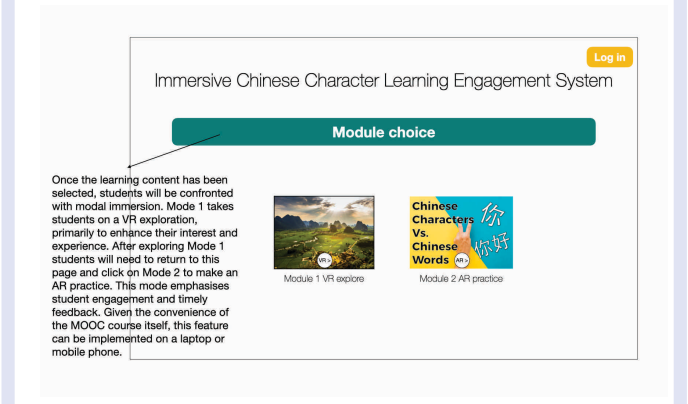
Scene merging

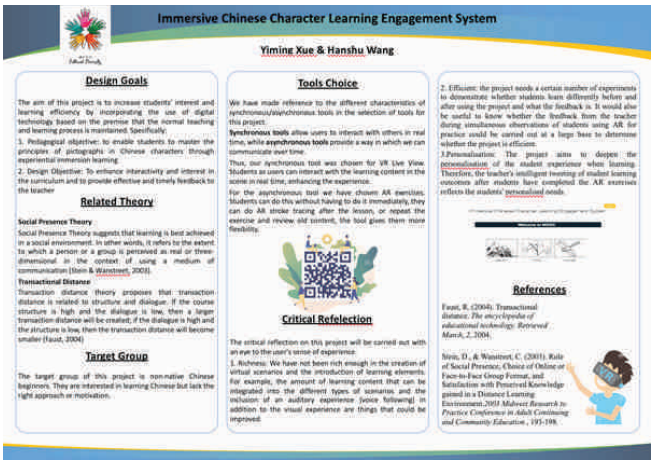




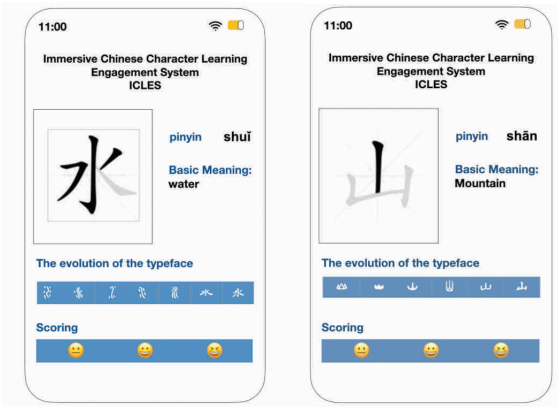
Final design







AR tracing



Evaluation

In the following, we will evaluate the final product based on the success of the design, as well as commenting on the successful achievement of the design criteria set out previously. In terms of the overall completion of the project, we think we have done our best to enhance the interactivity and interest, as well as the feedback. We created different teaching and learning experiences by building virtual scenarios, augmented learning practices with new technologies, and the demonstration video above shows us in action.

The bigger challenge for us with the ICLES system was to build different styles of virtual scenarios. This operation needs to be based on strong data support, so this is a direction that our project needs to follow up on. The AR tool will allow students to practice in real time, and once the Chinese characters in the dictionary have been entered into the system, they will be able to practice on their own with the help of this model. This will boost their confidence in learning Chinese characters.

Of course, there are still many aspects of our project that need to be improved in terms of technical operation, implementation costs and aesthetic design. In addition, embedding pronunciation guidance in the virtual scenario is also a feature worth considering. Therefore, upon completion of the full project, we will review the principles of the initial design for theoretical evaluation and improvement.

Design Criteria Evaluation

We have set design criteria previously to evaluate some key aspects of the ICLES system, which are Personal Motivation, Interaction, and Feedback. Moreover, we also designed some specific issues in each aspect. These issues will help us to understand whether we have solved the initial problems that inspired our project. Nevertheless, as we did not finish the experimentation and data survey of this project, this evaluation only could be regarded as a draft. If the feedback and data collection is completed, we believe that will prove the evaluation results, as well as promote our project to be feasible and available.

Personal Motivation

Our project could demonstrate improvement in personal motivation from two aspects. In Mode 1, no matter the categorized content interface or the virtual sense presented by VR, they both help learners immerse in the Chinese learning environment, which could facilitate interests of learners towards Chinese characters. In Mode2, learners` interests are inspired by tracing strokes order practices, which improved their learning motivation in the processes of exercising.

Interaction

In the research of Koedinger et al in 2015, the authors supported that in online learning courses, interactive activities will better enhance student learning outcomes. According to the previous design criteria, understanding and practicing are two main aspects that are needed to be evaluated in analyzing the effects of interaction. Learners firstly interacted with the learning environment by VR technology, which facilitated their understanding of each Chinese character. In the following, the interaction between learners and stroke tracing is worthwhile for them to learn and memorize the characters.

Feedback

As mentioned above, we evaluated the professionalism, quantity, and credibility of the feedback in our project. Because the feedback of our project is all provided by teachers during or just after the teaching processes, it is successful that this feedback avoided drawbacks of computer evaluated assessment and peer assessment. Therefore, the professionalism and timeliness is guaranteed in the feedback of our project. However, the defect of teacher manual evaluation is obvious. Due to the affordability of each teacher, the quantity of feedback, or in other words, the quantity of learners could just be limited in small scale, which is incompatible to accommodate a large number of learners in MOOCs.

Although, when it comes to the challenges we focused on before the beginning of this project, there are some defects that could not find solutions in the ICLES system, which also affects the results of our evaluation. Democratization is a significant issue in the debates of MOOCs. Despite the cost of AR/VR devices, our system also requires higher ICT accessibility and digital learning ability for learners and a large number of learning materials input, which would cause the inequity problem in education opportunity worse. Furthermore, plagiarism was not concerned in assessment of our project, so this issue needs to be explored in our further research.

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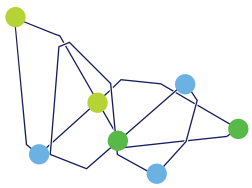

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